VOLUME 83 NUMBER 8

POWER

POWER TOPICS CROSS-INDEX

STEAM GENERATION
POWER GENERATION
WATER POWER
DIESEL & GAS ENGINES
AIR CONDITIONING & HEATING
REFRIGERATION
PUMPS & COMPRESSORS
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AUGUST, 1939

Joint utility-industrial Louisiana Station adds capacity 58
Where and how to use flowmeters—first of a series 62
pH guides selection of materials for feedwater pumps 64
Condensate in generator air coolers saves bleed steam 67
Wood-stave pipe repaired under pressure for hydro plant ... 68
Power serves process—ingenious new turbine controls 70
Low-cost air ejectors are replacing outmoded air pumps 72
English research men test wear in coal-dust engines 75
Getting your money's worth in buying synchronous motors .. 76
Examples of gas-flow control for flyash, dust collectors 79
New 1200-lb. gas-fired boiler for Masonite Corporation 82
Editor Swain tells of engineering highlights on West Coast .. 84
NDHA annual meeting looks forward to world of tomorrow .. 87
Fire-protection equipment for air-conditioning systems 88
Towards a better diesel—oil and gas power annual meeting .. 90
45 years on the line—Rochester, N. Y., bipolar generators ... 93

THE OPERATING ENGINEER

Small Boiler, Big Job 97
Orsat on Wheels 100
Questions and Answers ... 101
Practical Aids 102
Readers' Problems 106
Argument Corner 109
Headwork Section 110
How to Socket Wire Rope 111

OTHER DEPARTMENTS

Exhaust Lines 71
Engineers' Bookshelf 114
Power Lines 114
Data Sheet No. 85 124
New Plant Equipment 126
George Edwards 132

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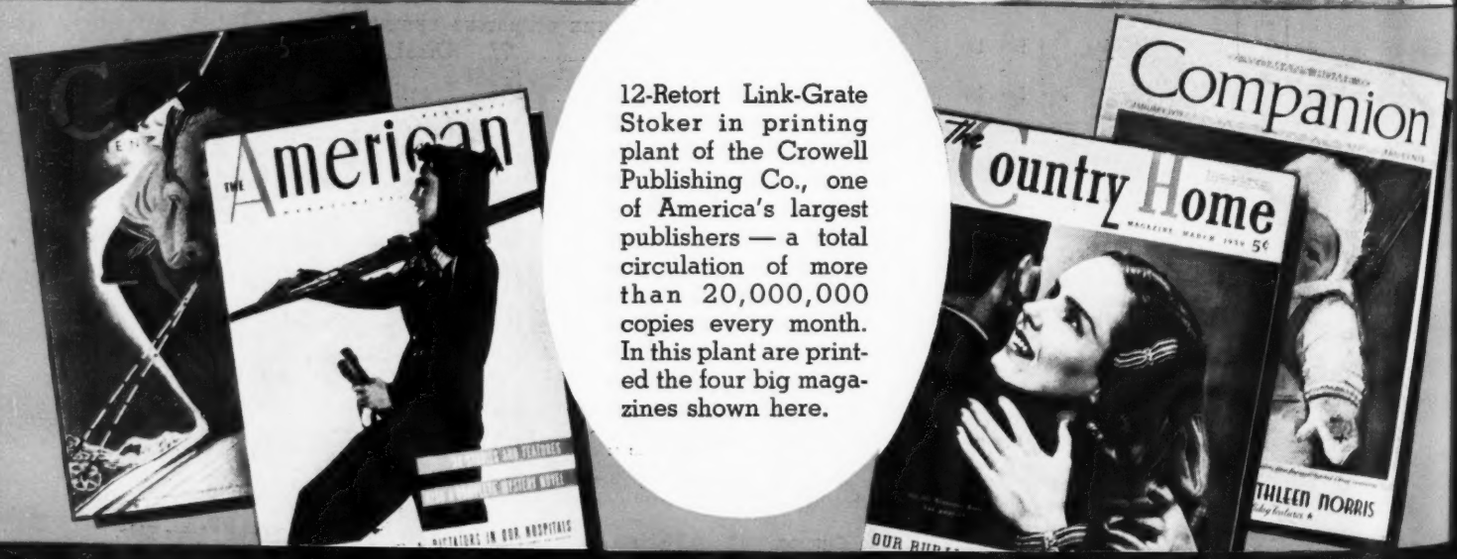
STEAM



12-Retort Link-Grate Stoker in printing plant of the Crowell Publishing Co., one of America's largest publishers — a total circulation of more than 20,000,000 copies every month. In this plant are printed the four big magazines shown here.

Westinghouse

POWER

Established 1882 PHILIP W SWAIN, Editor

Profit from Cooperatives

From the days when wind, falling water, and animals in harness were the only power sources down to 1888, there was one simple pattern of power generation. Men made power and used it on the spot. Edison's Pearl Street central-station changed all that—created a new power pattern, challenging engineering imaginations. For the first time men could make power in one place and apply it at a distance. What was the result?

By making power in big blocks at a central point, diverse needs of power users were satisfied with less total equipment, less waste. Central-station engineers, whose business was making power, could and did concentrate on rendering always cheaper and better service. Because it filled a real need, because it was economically sound, Edison's local experiment grew by leaps and bounds into the giant central-station industry, turning out 100 billion kwhr in its golden anniversary year, 1938. But did it wipe out isolated generation? Everyone knows the answer—

The older pattern persists. Power continues to be made on the spot. Why? Size isn't the reason, for plants ranging from five to half a million horsepower serve industry in all parts of the country. Location isn't the reason, for many private plants serve industry where central-station power is readily available. The answer is that local, "on-the-spot" power proves more economical than even the least-costly transmitted power when demands for electric power and process heat can be met from a single coordinated plant. Two power patterns, each with its job, each doing it well—but the world doesn't stand still. Here and there, where power-makers and power-users look at facts with imagination and without prejudice, there appear glimpses of a new pattern, with cooperation as its keynote. Why?

In a nutshell, cooperation can combine advantages of central-station and isolated generation. Industry needs both steam and power, and every kwhr it can produce from process steam is cheap power. Lack of balance between steam and power demands prevents making the most of byproduct generation. Low steam demand means higher-cost condensing power; low electric demand means wasteful direct steam generation. Cooperation between grouped industrials helps to better the balance but what's really wanted is a huge flywheel—to put and take energy as needed, to keep total cost of steam and power to a minimum. That's where the utility comes in—its distribution system and interconnections do the flywheel trick.

Read for yourself, in this issue, about the largest cooperative plant—Louisiana Station. Think back over the record hung up at Schenectady by the mercury plant of General Electric—New York Power and Light. Cast a glance at the West Coast where the farsighted Pacific Gas and Electric Co is building three plants for joint utility-oil refinery service. Dig into some of the other, less publicized ventures in cooperation. All reported experience indicates owners uniformly consider cooperation a success. Why not more if it is a good thing?

Growth of this third pattern waits on two things. Engineers with imagination must see cooperative possibilities and develop them soundly. But even more important, executives with vision must cut through inertia, prejudice, and red tape to a just allotment of costs, responsibilities, and returns. Cooperation isn't easy—nothing worthwhile is. Joint operation bristles with economic and engineering problems, but nothing profit-minded engineers and power-conscious executives can't lick.

Louisiana Station Extended

Joint utility-industrial plant at Baton Rouge meets increased demands for steam and power by installing two additional 500,000-lb-per-hr, natural-gas- or oil-fired steam generators and two 15,000-kw extraction-condensing turbines

By A C KLEIN
Chief Mechanical Engineer
Stone & Webster Engineering Corp

THE LOUISIANA STATION was constructed in 1929–1930 to generate steam for sale to a single large industrial customer, the Standard Oil Company of Louisiana, and to recover byproduct electrical energy from steam sold and steam needed to drive auxiliaries and to heat feedwater. Some of the energy went to the refinery but the greater part went into local distribution in Baton Rouge or to the interconnected system of the Gulf States Utilities Company.

The station operation proved so satisfactory that the company faced in 1937 the need for a substantial increase in its facilities to supply the growing steam and power requirements of Standard Oil Company and of two additional customers, The Solvay Process Corporation and Ethyl Gasoline Corporation.

In 1930, the station contained five boilers and three noncondensing turbines, having a total capacity of 1,800,000 lb of steam per hr and 45,000 kw. It was designed as a high make-up station, 75% of feed entering boilers was treated Mississippi River water and only 25% condensate. This necessitated an extensive water-treating plant.

Steam was generated at 650 lb, 750 F, and exhausted at 140 lb gage. The principal auxiliaries were turbine-driven, using 140-lb steam and supplying exhaust for feedwater heating. A 140-lb heater supplied the final step in heating feedwater. As contracts with industrial customers provided for supply of waste fuels, the combustion system also included provision for burning gas, oil, petroleum coke and several kinds of refinery wastes.*

The 1938 extension comprises two 500,000-lb-per-hr boilers, two 15,000-kw main turbines and auxiliaries. Figs. 2 and 3 show the general arrangement.

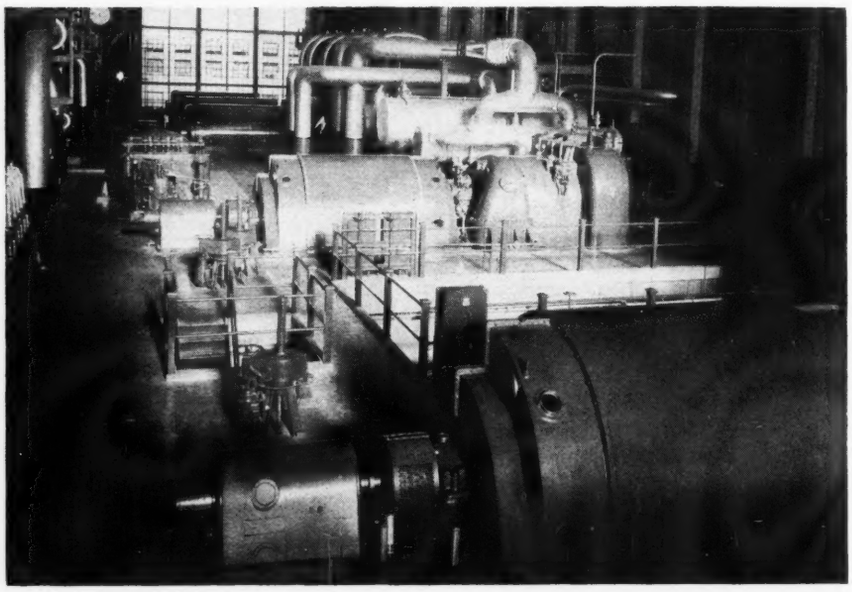


Fig. 1—View of turbine room with new 15,000-kw, extraction-condensing units in the foreground. Note governor end of feed-heating turbine at left

In many basic features such as steam conditions, high makeup and steam-driven auxiliaries, the extension conforms to original station design. In other respects, changed conditions have necessitated modifications. Thus, the new turbines can operate to duplicate the duty of the original units, that is, to generate 15,000 kw of noncondensing power, but they also have low-pressure stages which permit them to operate partly or wholly on condensing cycle.

In the boiler plant, furnace design was simplified by omitting provision for burning refinery wastes, as the older boilers have adequate capacity to handle the amount available. Enlargement of the station output permitted adding a turbine to recover additional energy from feed-heating steam. The blowdown heat-recovery apparatus was modified and other changes made to improve utilization of feed-heating steam. Many improvements made while enlarging the water-treating plant brought its design in line with best modern practice.

In planning the building extension to house the new boilers, turbines and auxiliaries, the two principle objectives were operating convenience and comfort. Convenience was secured by maintaining all operating grades at the same levels as those in older parts of the station, and by laying out operating floors, platforms, and stairways to give free access and ample working space.

The first step toward obtaining comfortable working conditions was to reduce radiated heat from equipment. This was accomplished by providing a generous thickness of heat insulation, particularly on the new boilers, where a review of the specifications led to adding 2 in. of magnesia insulation to the normal thickness, solely for operating comfort. A sub-roof of asbestos-protected metal underneath the tile roof protects the turbine room and electrical bay against sun heat.

In both boiler and turbine rooms liberal use was made of roof ventilators and in the boiler room large grilles at each end of the fan bay supply outside

* For description of economics of operation and contractual arrangements, see "Economics of a Power Plant for Joint Utility and Industrial Service" by A C Klein and T E Crossan, *Mechanical Engineering*, February, 1939.

air as directly as possible, so fan draft does not interfere with upward flow of hot air from the operating level to the roof. Many grating platforms above the operating level also facilitate ventilation.

Ten forced-draft mechanical-atomizing burners fire each of the two new 500,000-lb-per-hr, 4-drum, Stirling boilers with oil and natural gas, separately or simultaneously. The design also provides for the future use of refinery gas. Furnaces are watercooled except for a refractory section around the burners and a refractory floor to aid ignition. A flue-gas damper, with automatic control, bypasses sufficient gas around the superheater above half-load to hold superheat constant at 750 F between half and full load. No economizers were installed, but each boiler unit has two 24,400-sq-ft Ljungstrom air heaters. Normal fuel will be natural gas and, when burning it, slightly over 82% combined efficiency is guaranteed at full load. This corresponds to an exit-gas temperature of 330 F.

Two duplex fan sets serve each boiler. Each consists of a forced- and induced-draft fan on a single shaft, driven by a high-efficiency steam turbine through reducing gears. The turbines use 140-lb steam from the main turbines and exhaust to deaerators at 7 lb gage. The fan operation is controlled by a central combustion-control system, which varies the turbine speed and adjusts auxiliary damper equipment.

Up to the present, Louisiana Station operations have always produced surplus electric energy available for local domestic distribution. In the near future, however, this condition will change because large increases in power requirements of its industrial customers

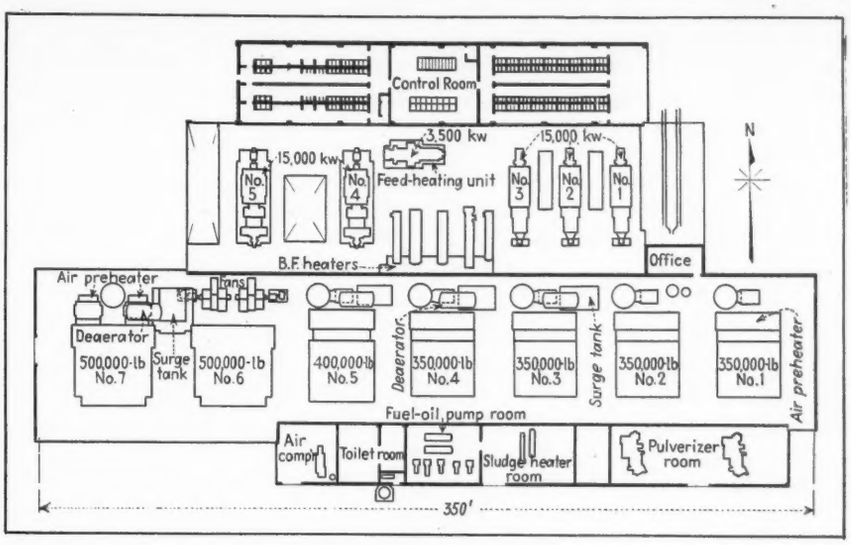


Fig. 3—First section of plant made byproduct power only and is equipped to burn pulverized refinery waste. Extension features larger, natural-gas-fired boilers, turbines that can make primary power when needed

may completely absorb all energy generated by the steam they purchase.

To meet these new conditions, the two extraction-condensing turbine-generators can be operated exactly like the existing units or wholly as condensing units, or as combined extraction and condensing units. High and low-pressure elements are each controlled by an external valve chest and separate governing mechanism. The high-pressure section contains a single-stage impulse wheel and nine rows of reaction blading and the low-pressure section a single-stage impulse wheel and 13 rows of reaction blading.

Speed-responsive and constant-back-pressure governors provide regulation under the several different operating conditions. Each machine can generate 15,000 kw when operating with complete steam extraction at 140 lb, or 18,750 kw when operating with no extraction, but with maximum steam flow to condenser. Under certain conditions of combined extraction and condensing operation, each unit can generate up to 25,000 kw. The turbines also have uncontrolled extraction openings which deliver steam at 5 lb gage at maximum flow. By heating condensate this extraction improves the economy of condensing operation and decreases the load on condensers and cooling towers.

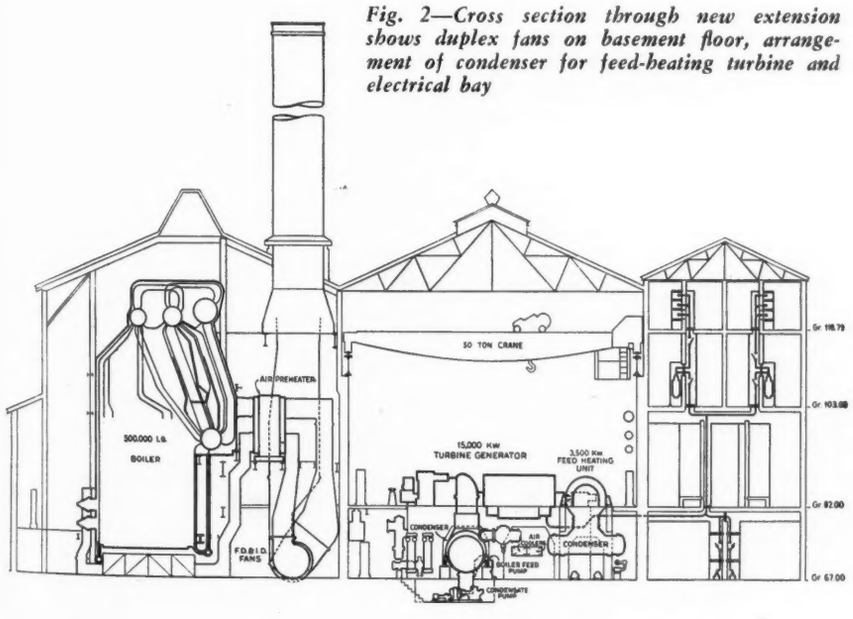


Fig. 2—Cross section through new extension shows duplex fans on basement floor, arrangement of condenser for feed-heating turbine and electrical bay

Byproduct Power

Whenever the station as a whole produces surplus energy from steam made for its industrial customers, the new turbines operate noncondensing, under control of their backpressure governors. If the system calls for additional power, the low-pressure governors open and permit steam to flow to the condenser to generate the added load. At such times 140-lb pressure is maintained ahead of the secondary valves by the backpressure regulator which operates to increase the turbine throttle flow by the amount going to condenser. The turbines are designed to operate in this manner for steam flow to condenser up to 155,000 lb per hr, corresponding to a condensing load of 15,000 kw. At that load the secondary valves are wide open. Disengaging the bleeder valve and allowing the extraction pressure to rise, permits increased flow to condenser and loads up to 18,750 kw.

Each turbine drives a 13,800-volt, 3-phase, 60-cycle, 0.80-pf, 3,600-rpm, 25,000-kva generator, normally operated with grounded neutral. Closed recirculating air systems, with tubular coolers using plant makeup water, cool

the generators. Excitation comes normally from direct-connected, 100-kw exciters, at 250 volts; emergency excitation comes from a turbine-driven exciter previously installed.

An automatic fire-protection system will flood the air ducts of any generator with CO_2 in case of abnormally high machine temperature. The older generators, which had only water protection, are now also protected by CO_2 systems.

Each turbine exhausts to an 11,700-sq-ft 2-pass surface condenser designed to condense 190,000 lb per hr at 26 in. Hg vacuum when circulating 15,000 gpm of 90-F water. Circulating water comes from cooling towers; a new forced-draft tower just south of the plant meets added water requirements.† Each condenser has two circulating water pumps with a combined capacity of 15,000 gpm and two 475-gpm condensate pumps, all motor driven.

The turbines will operate noncondensing for considerable periods during which the condensers will receive only the small quantity of steam needed to cool low-pressure blading. At such time, one circulating pump supplies sufficient cooling water for both condensers and the circulating-water piping arrangement permits this. The condensate likewise falls off during such periods, therefore small condensate pumps, of 100 gpm each, have been provided to save auxiliary power. Air is removed by steam jets, with condensate recirculated to the condensers for cooling when necessary.

† A future article will describe unusual features of cooling tower installation.

Boiler-Feed Pumps

The initial station contained four 1,500-gpm, turbine-driven, centrifugal boiler-feed pumps. With the new extension a fifth similar pump was added. Improvements in the control equipment of all five pump turbines made it possible for full pump capacity to be maintained automatically under emergency conditions of high back-pressure or low throttle pressure. Two new 700-gpm high-pressure drip pumps operate against the same head as boiler-feed units. Their driving turbines exhaust into the same heater condensers as the main boiler-feed-pump turbines.

The plant extension also includes two 500,000-lb-per-hr deaerating heaters, high- and low-pressure blowdown heat exchangers, a 140-lb heater and two additional feedwater heaters, one to condense steam from the boiler-feed pump and high-pressure drip pump turbines and the other to condense steam from the feed-heating turbine.

The high efficiency of byproduct-power recovery obtained at Louisiana Station can be attributed in large measure to special care taken to heat feedwater in many steps with minimum degradation of heat at each. The simplified flow diagram, Fig. 4, shows how this principle was applied. Following the progress of feedwater from right to left, it can be seen that eight separate feedwater heating operations take place. In the first two, low-temperature incoming water absorbs waste

Principal Power-Plant Equipment

1938 EXTENSION — LOUISIANA STATION, GULF STATES UTILITIES COMPANY

Stone & Webster Engineering Corporation, Engineers and Constructors

Steam-generating equipment:

Boilers, water walls, superheaters, settings.....Babcock & Wilcox Co
Two 4-drum Stirling units, 28,655 sq ft heating surface, 7,870 sq ft superheater, 3,816 sq ft partial-studded water wall. Max cont rating: 500,000 lb per hr, 650 lb, 750 F. Guar full-load eff: 82.17%, incl air heater. Furnace vol: 24,000 cu ft. Heat rel: 26,700 Btu cu ft.

Air heaters, 2 per blr, Ljungstrom regenerative.....Air Preheater Corp
24,400 sq ft, each. Max air temp, full load: 577 F (with natural gas)

Boiler heat insulation.....The Philip Carey Co

Safety valves.....Consolidated Ashcroft Hancock Div

Non-return valves.....Schutte & Koerting Co

Feedwater regulators.....Stets Co

Burners, 10 per blr.....Peabody Engineering Corp
Forced-draft, mechanical-atomizing, combination oil and natural gas, designed for future burning of refinery gas.

Fuel-oil pumps.....Quimby Pump Co
One 160 gpm, motor-driven; one 90 gpm, turbine-driven

Fuel-oil heaters.....Ross Heater & Mfg Co

Combustion control, Smoot system.....Republic Flow Meters Co

Draft equipment:

Fans, 2 duplex units per blr.....B F Sturtevant Co
One 80,000 cfm, 100 F, 16.5 in. sp, forced-draft; one 125,000 cfm, 360 F, 15 in. sp, induced-draft; both on same shaft

Fan turbines and reduction gears.....The Terry Steam Turbine Co
Four 700-hp. non-condensing unit. Throttle: 135 lb g, 440 F. Exhaust: 3 lb g, Herringbone gears, 5,000/1270 rpm.

Steel plate work.....Chattanooga Boiler & Tank Co

Stacks, one per blr.....Virginia Bridge Co
10 ft 10 in. x 114 ft 3 in., brick-lined, self-supporting steel

Feedwater system:

Feedwater-heating turbine.....General Electric Co
One 3500 kw, 3600 rpm condensing. Throttle: 135 lb, 440 F. Exhaust: 3-5 lb abs. Relocated from Govt St Sta, Baton Rouge Elect Co

Feedwater-heating-turbine condenser.....The Griscom-Russell Co
One 3595 sq ft, 2-pass surface type, ⅝-in. welded-steel tubes

Boiler-feed pump.....Ingersoll-Rand Co
1500 gpm, 4-stage, 3550 rpm. Suction press: 20 lb g. TDH: 1936 ft.

Feed-pump turbine.....The Terry Steam Turbine Co
1000 hp, 3550 rpm. condensing. Throttle: 135 lb g, 440 F.

High-pressure-heater drip pumps.....Ingersoll-Rand Co
Two 350,000 lb per hr, 5-stage, 3550 rpm. Water temp: 355 F. TDH: 1700 ft

H-p heater drip-pump turbines.....The Terry Steam Turbine Co
Two 450 hp, 3550 rpm. Throttle: 135 lb, 440 F. Exhaust: 20 lb abs. Direct-connected.

Deaerators.....Elliott Co
Two 500,000 lb per hr, horizontal shell, direct contact, non-surge, working press. 3 lb g. Two vent condensers per deaerator, 183 sq ft each, ⅝-in. tubes, single-pass.

High-pressure feedwater heater.....The Griscom-Russell Co
One 7711 sq ft, U-tube, ⅝-in. Admiralty tubes. Capacity: 1,600,000 lb per hr feedwater at 800 lb, 235,000 lb steam at 135 lb. Temp range: 220-350 F.

Low-pressure feedwater heater.....The Griscom-Russell Co
One 3340 sq ft, U-tube, ¾-in. Admiralty tubes. Capacity: 1,400,000 lb per hr feedwater at 125 lb, 35,000 lb per hr steam at 3.5 lb abs. Temp range: 116-139 F. Two 70-gpm motor-driven condensate pumps; one twin-element, single-stage air ejector and inter-after condenser.

Extraction heaters.....The Griscom-Russell Co
Two 430 sq ft, U-tube. Capacity: 200,000 lb per hr condensate at 125 lb, 20,000 lb per hr extracted steam at 22 lb abs. Temp range: 124-209 F.

Blowdown heat exchangers.....The Griscom-Russell Co
One high-pressure, 3180 sq ft, U-tube. Capacity: 350,000 lb per hr blowdown at 650 lb, 2,500,000 lb per hr feedwater at 800 lb. Temp range: 350-370 F.
One low-pressure, straight-tube, 2937 sq ft, ⅝-in. Admiralty tubes. Capacity: 250,000 lb per hr blowdown at 30 lb, 1,400,000 lb per hr feedwater at 125 lb. Temp range: 97-123 F.

Electric generating equipment:

Turbine-generators.....Westinghouse Electric & Mfg Co
Two 15,000-kw, combined extraction-condensing 3,600-rpm turbines. Throttle: 600 lb, 725 F. Extraction: 140 lb. Exhaust: 4 in. Hg abs. Two 3-phase, 60-cycle, 13,800-volt, 0.80-pf, 25,000-kva generators. Four oil coolers, two per unit. Two generator air coolers, 5,680 sq ft fin-tube cooling surface, in two sections for each generator. Two exciters: One 100 kw, 250 volt, direct-connected to each generator.

Condensing system:

Condensers and auxiliaries.....Worthington Pump & Machinery Co
Two 11,700 sq ft, 2 pass, ⅞-in. OD Admiralty tubes. Circulating water pumps, 2 per cond, 7500 gpm, 80-ft hd, 200-hp motor. Main condensate pumps, 2 per cond, 475 gpm, 185-ft hd, 40-hp motor. Auxiliary condensate pumps, 1 per cond, 100 gpm, 240-ft hd, 15-hp motor. Air removal equipment: duplex twin-jet units, 1 per cond.

Cooling tower.....Schubert-Christy Corp
One 18-cell forced-draft tower. Capacity: 30,000 gpm from 118 to 94 F. Structure: 60 ft wide, 166 ft long, 36 ft high—redwood. 18 forced-draft fans, axial flow, adjustable pitch, each with 20-hp motor and V-belt drive. Capacity: 154,000 cfm each.

Miscellaneous auxiliary equipment

Service pump, 4000 gpm, 1750 rpm, 275 ft.....Ingersoll-Rand Co

Service-pump turbine, 350 hp, 1750 rpm....The Terry Steam Turbine Co

Aux circulating pump, 300 gpm, 94-ft hd.....Ingersoll-Rand Co

Deaerator surge tank.....The Petroleum Iron Works Co

Lubricating-oil equipment.....S F Bowser & Co Inc

Air compressor.....Ingersoll-Rand Co
Capacity: 293 cfm free air, 100 lb g, 60-hp motor, V-belt drive.

Instruments

Natural-gas flowmeters.....American Meter Co

Steam flowmeters, water-level recorders.....Bailey Meter Co

CO_2 recorders, industrial thermometers.....C J Tagliabue Mfg Co

Temperature, conductivity, pH recorders.....Leeds & Northrup Co

9-point draft gages.....Ellison Draft Gage Co

Indicating pressure gages.....Consolidated Ashcroft Hancock Div

Dial thermometers, recording thermometer.....The Foxboro Co

Condenser vacuum gages.....Taylor Instrument Co

Piping and valves

Gate valves.....The Chapman Valve Mfg Co

Globe valves.....Reading-Pratt & Cady Co; Wm Powell Co; Henry Vogt Machine Co

Check valves.....Wm Powell Co

Pipe and fittings.....Midwest Piping & Supply Co Inc; Crane Co; Benjamin F Shaw Co

Insulation.....Taylor-Seidenbach Corp (Johns-Manville)

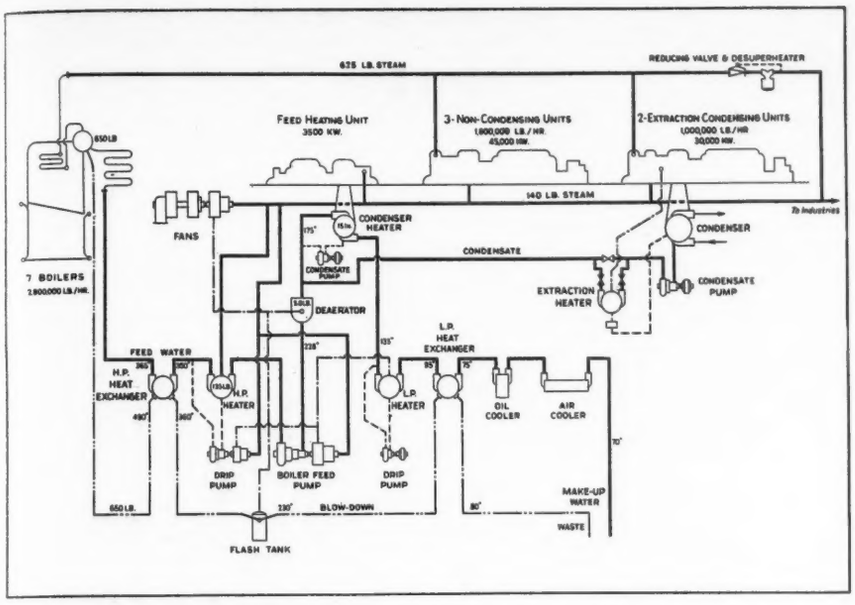


Fig. 4—Eight separate feedwater-heating operations suit high makeup. Blowdown, 7-15%, goes to waste after being cooled to within 10 deg of incoming treated water

heat from the air and oil coolers of the five main turbine-generators and of the feedwater heating turbine. In two other steps, heat is transferred from blowdown to feedwater in heat exchangers. Heat is also recovered from low- and intermediate-pressure steam in four more steps, each at successively higher pressures and temperatures.

Heat Recovery

Special interest attaches to the recovery of heat from boiler blowdown water. Being a high makeup station, the plant operates with high blowdown, ranging from 7 to 15%. Blowdown water leaving the boilers, at drum pressure of 650 lb and at 515 F, first passes through a high-level heat exchanger in which its temperature is reduced to 360 F. From a practical standpoint no heat degradation occurs as the feedwater is already at a temperature higher than that available from any other source of heat.

The blowdown next enters a flash tank, where its pressure is reduced to 7 lb gage; approximately 15% by weight flashes into steam, which mixes with the exhaust of the fan turbines to heat feedwater and remove oxygen in deaerating heaters. By this flashing operation, the waste water quantity is reduced and its temperature reduced to approximately 220 F. At that temperature it enters a low-level heat exchanger which cools it further by transferring heat to makeup water coming from air and oil coolers. This process lowers its temperature to about 80 F only a few degrees above the temperature of the makeup supply entering the station.

Auxiliary exhaust heats feedwater in two stages. More than half of the steam is used to pump feedwater to the boilers by main feed pumps and high-pressure drip pumps. Their high-efficiency turbines exhaust into two surface condensers whose condensing medium is water from the outlet of the low-pressure blowdown heat exchanger. The use of this low-temperature water enables the turbines to expand steam to a low vacuum (3 to 5 lb abs) and to require much less steam than if they exhausted into the deaerator system.

The remainder of the auxiliary-drive steam goes principally to fan turbines. These are also high-efficiency machines and supply plant deaerators, supplemented by steam flashed from the blowdown system, as described above. As will be shown later, steam saving made possible by efficiency of auxiliary turbines themselves or by low backpressure conditions is reflected as a direct gain in station output of byproduct power.

The auxiliary turbines are so efficient that their exhaust is insufficient to heat and deaerate the feedwater supply. A 140-lb feed-heating turbine has therefore been installed to supply the deficiency. This unit exhausts into a condenser in which feedwater on its way to the deaerators condenses the steam.

The turbine throttle flow is controlled automatically to maintain a uniform pressure in the deaerators. Its amount varies with temperature of the water entering the condenser and with the amount of steam available for deaeration. As the temperature of water entering the station changes between summer and winter, its temperature entering the turbine condenser fluctuates likewise.

Another contributing factor is fluctuation in boiler blowdown. As the blowdown increases, the heat abstracted from it in the low-pressure blowdown exchanger also increases, causing the water temperature to the condenser-heater to rise. An increase in blowdown also produces more steam from the blowdown flash tank, and its condensation in the deaerators can only be accomplished by lowering the temperature of water from feedwater turbine condenser. It can thus be seen that the feed-heating turbine must be responsive to all of the factors which influence feedwater temperature, not only before the condenser but also after it enters the deaerator.

The combined back-pressure and temperature control for regulating steam flow to this turbine is interesting. The basic control point is pressure in the deaerators. Any of the factors described as influencing the transfer of heat to the feedwater finally make their effect felt on deaerator pressure. Any surplus of deaerator steam or excess of water temperature causes this pressure to rise. Conversely, a deficiency of steam or drop in water temperature causes it to fall. Regulation of the feedwater turbine is therefore accomplished by causing its steam admission valves to open or close so as to maintain a predetermined pressure of 5 lb gage in the deaerator shell.

Constant Deaerator Pressure

To make the system more responsive and to give effect to the flywheel action introduced by the heat content of water in the condenser, the actual control impulse comes first from pressure in the condenser heater, with a correcting impulse from the deaerator. In other words, the turbine operates to maintain a uniform pressure in its condenser, but that uniform pressure is subject to variation in order to maintain a constant pressure in the deaerator shells. The economy of the feedwater heating unit is evidenced by the fact that during March 1938 it generated over 1,000,000 kwhr, a clear gain in station output.

The installation of drip pumps to receive condensate from various heaters and condensers and deliver it into the feedwater stream beyond the respective heaters which they serve, contributes substantially to station efficiency. Handling condensate in this manner, instead of cascading it to a lower heat level, materially increases utilization of the possibilities of the regenerative cycle.

Where and How to Use Flowmeters

1

Instruments play an important part in power-plant operation—to use them intelligently requires a knowledge of construction and service. This, the first of a series, gives brass-tacks information about differential-pressure devices

OF THE SEVERAL CLASSES of meters for measuring flow of liquids, steam and gases, most generally used are those known as head meters. Head meters derive their name from the use of a device in the stream of fluid that creates a difference of pressure, or a differential head, which depends upon velocity and density of the liquid.

These meters comprise three essential units:

1. A pressure differential device, frequently called the primary element, in contact with the fluid to be measured.
2. The meter body, which measures the differential pressure created by the differential device.
3. The indicating, recording and integrating instruments. Each of these may be built separately or all combined into a single unit.

The meter body and instruments are frequently referred to as the secondary element. Only differential-pressure head devices will be considered in this article.

A pressure-differential device is the unit placed in the liquid stream or gas line to create a differential pressure which is a measure of the rate of flow of the liquid through the pipe. For closed pipes, these devices may be a thin plate orifice, a flow nozzle, a pitot tube or a venturi tube.

Disk Orifice

If a disk orifice is placed in a pipe line, Fig. 2, and pressure measurements made along the pipe when fluid is flowing, a pressure variation will be found similar to that indicated by the heavy lines. This occurs because of a change in velocity of the fluid.

On the upstream side, because of an abrupt change in the flow area, there occurs a slight rise in pressure at the orifice plate. On the downstream side, minimum pressure does not occur at the orifice, but at some distance away from the plate. This point is where the jet through the orifice attains its greatest velocity; there the velocity head is the highest and static head at a minimum, which is what is actually measured by the liquid in the tubes. At the point of minimum pressure the jet also has a minimum diameter.

If a mercury U-tube is connected into the pipe as in Fig. 2, the mercury in its upstream leg will be lowered and will rise in the downstream leg. The difference in levels represents the difference in static pressure (the differential pressure) in inches of mercury between the two points in the pipe where the U-tube connects. This pressure drop varies as the square of the velocity and can be used as an accurate index of the rate of flow.

In flowmeters, the flow mechanism measures this differential head and translates it into units of flow for indicating and recording the volume flowing at any instant, and for integrating and recording, the volume flowing in a given period. The flow mechanism can take the form of a mercury U-tube arrangement with a float in it, as in Fig. 1. The float connects to a shaft that actuates the metering mechanism. When the mercury changes its level in the U-tube as the differential pressure changes with flow, the float rises or falls accordingly to transmit the flow changes to the metering element.

Thin-plate orifices are widely used to obtain a pressure differential. They have the advantage of low initial cost, are easy to install as they can be placed in existing flanges of the pipe, can be used for either large or small capacities, easily changed for a change in capacity, and are accurate if properly used.

These orifice plates are thin metal disks usually made of Monel metal but stainless steel and bronze may also be used. They are normally made with a round hole in the center of the disk.

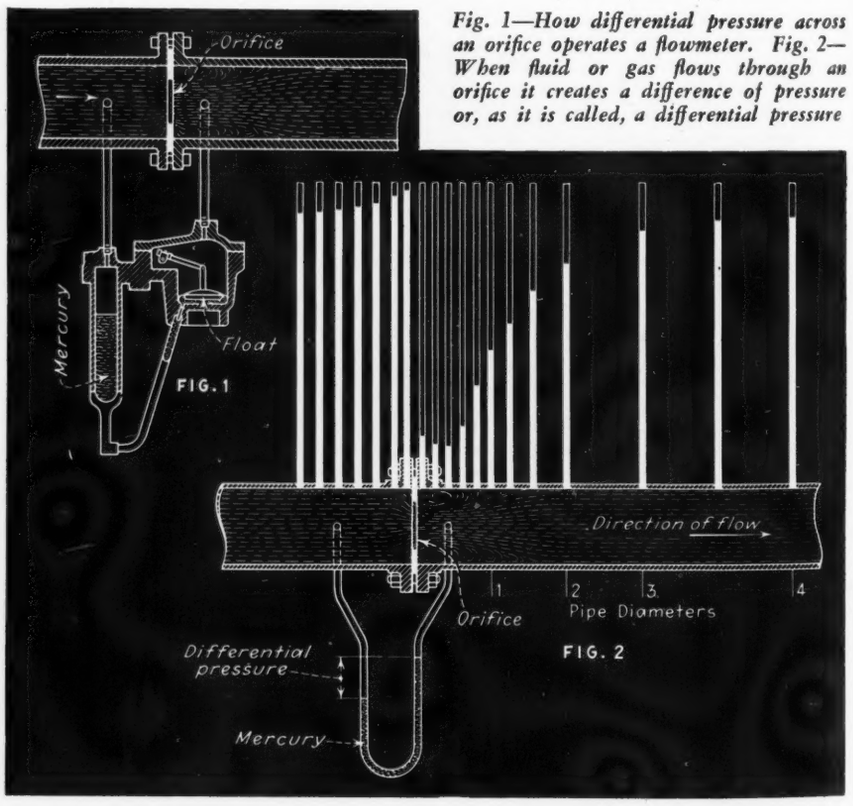


Fig. 1—How differential pressure across an orifice operates a flowmeter. Fig. 2—When fluid or gas flows through an orifice it creates a difference of pressure or, as it is called, a differential pressure

For large capacities, the hole may be placed in the bottom of the disk with the differential pressure connections taken from the top of the pipe. In other cases, a disk segment is fastened to the top side of the pipe.

The hole in the disk is calibrated to give the required differential head for specific conditions of flow. It is generally beveled to an angle on the downstream side with a sharp edge at the entrance to the orifice. Other forms are also used. A high degree of accuracy is required in making these plates and unless the meter user is in a position to satisfy these requirements, he should not attempt to make them.

Orifice Installation

The simplest form of a thin-plate orifice is one that is installed between the pipe flanges, Fig. 3. This type of installation requires very accurate placing of the downstream tap. To meet this and other conditions, several arrangements of orifice-plate and tap connections are used, such as in Figs. 4 and 5.

In Fig. 4, the downstream tap is in a ring that serves as an orifice-plate holder, and is clamped between the pipe flanges. Fig. 5 shows a carrier-ring assembly in which the orifice disk is carried on a steel ring. This ring has radial differential-pressure taps connecting to annular grooves in the ring that extend around the full circumference of the pipe bore. These grooves are intended to average the pressure over the face of the orifice and minimize effects of uneven distribution of flow across the pipe section because of pipe bends and valves in restricted areas.

For high-pressures, the orifice may be located in a flow unit as in Fig. 6. This is a factory-made job in which accuracy can be guaranteed—all parts are machined to dimensions and taps accurately located.

The flow nozzle, Fig. 7, another form of differential-pressure device, comprises a short cylinder with a flared entrance. A flange on this entrance permits the nozzle to be clamped between pipe flanges. This type of flow nozzle is recommended for use where a rugged differential device is required and where the expense of a venturi tube is not justified.

For small pipes, flow nozzles are frequently spun from a single sheet of metal, where, for the larger sizes they are cast and accurately machined. Location of the upstream taps with this type of nozzle varies from about 1-pipe diameter away from the nozzle to into the flange. The low-pressure tap may also be in the flange or downstream no farther than the end of the nozzle.

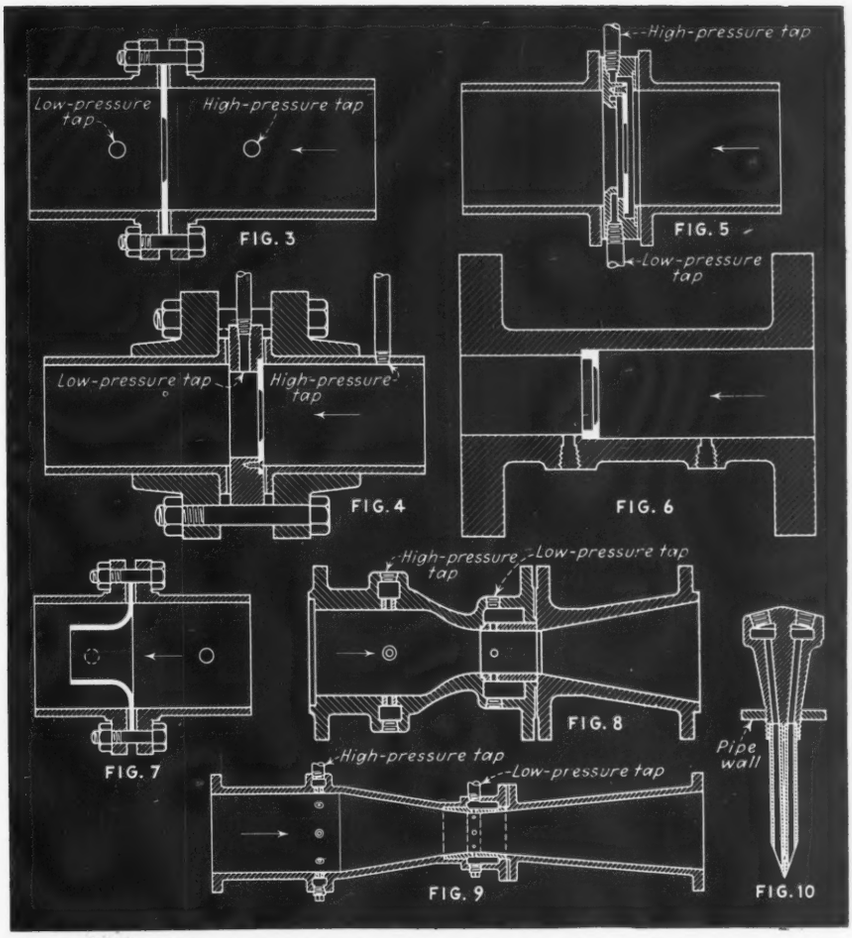


Fig. 3—Simple disk orifice held in pipe flange. Fig. 4—Orifice holder with low-pressure tap in pipe flange. Fig. 5—Orifice mounted on carrier, in which are the pressure taps, installed between pipe flanges. Fig. 6—Orifice plate and pressure taps placed in a high-pressure unit. Fig. 7—Flow-nozzle installed between pipe flanges. Fig. 8—Venturi nozzle with pressure-restoring cone. Fig. 9—Venturi tube with long entrance and exit cones. Fig. 10—Pitot tube comprising two tubes with beveled ends

A venturi tube, Fig. 9, is the best known differential-pressure device, but because of its cost, it has not been used as generally as some of the other devices. They are used extensively, however, on water-systems and other large water-flow lines. With reasonably steady flow, venturi tubes are highly accurate at any pressure and temperature and at capacities limited only by size of pipe in which they are installed.

Both pressure taps are made through annular chambers, known as piezometer rings. These chambers communicate with the interior of the tube by small vent holes. On the outside of the tube, a tapped hole is placed opposite each hole into the venturi tube and a pressure connection made to one of them. The other outside holes are plugged to serve as cleanouts.

Venturi nozzles, Fig. 8, are also used where space is too restricted to use a standard-length venturi tube. Head loss through a venturi nozzle is about double that for a standard venturi tube, but its initial cost is less and it requires less space to install.

Pitot tubes are used for measurement of fluids, but are not as common with meters as are orifices and venturi tubes. They are made in different forms. One, Fig. 10, consists of two small tubes screwed into a holder. Free ends of the tubes are beveled in opposite directions so that when they are placed in the pipe carrying the fluid, the bevel on one tube faces upstream and that of the other downstream in direction of fluid flow. The tube facing upstream is known as the impact tube as it receives the impact or velocity pressure of flow. The tube with its bevel facing downstream is known as the static-pressure tube—the only pressure it receives is from the static head of the fluid.

The devices shown give a general picture of those used to produce a differential pressure. Meter manufacturers, however, may use them in slightly different ways to meet the needs of their particular meters as determined by practice and research.

pH Guides Selection of Feed-Pump Materials

Most important factor in selection of correct metals for boiler-feed pumps is pH value of the feedwater. This article discusses the application of this comparatively new guide, pointing out pitfalls and shortcomings in its use

By J B GODSHALL
Chief Chemist, Ingersoll-Rand Co

USE OF pH values gives an arbitrary scale for measuring the activity of an acidic or alkaline solution instead of, as in common practice, measuring the quantity of acid or alkali in the solution. The latter is of little value in telling how corrosive a solution is because 1% solution of boric acid is an eye wash, of acetic acid, a weak vinegar, and of sulphuric acid a solvent of iron and steel. A similar comparison can be made with alkaline solutions. This difference in corrosive effects results because 1% solutions of these acids contain different concentrations of hydrogen ions, which are measured in pH units at room temperature.

Hydrogen ions are positively charged hydrogen atoms resulting from a breaking up of some of the acid molecules in the solution. Extent to which this occurs depends upon the kind of substance, how much of it there is in the solution, temperature of the solution and the presence of other substances, particularly inorganic compounds.

For this article it is sufficient to remember that the pH scale extends from

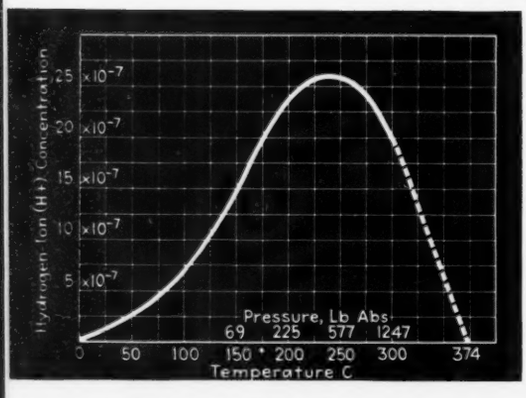


Fig. 1 (Above)—Hydrogen-ion concentration of pure water at different temperatures

Fig. 2 (Upper right)—One 252-hp turbine-driven, 550-gpm and two 200-hp synchronous-motor-driven 365-gpm boiler-feed pumps, operating against a 1260-ft head in a large industrial plant

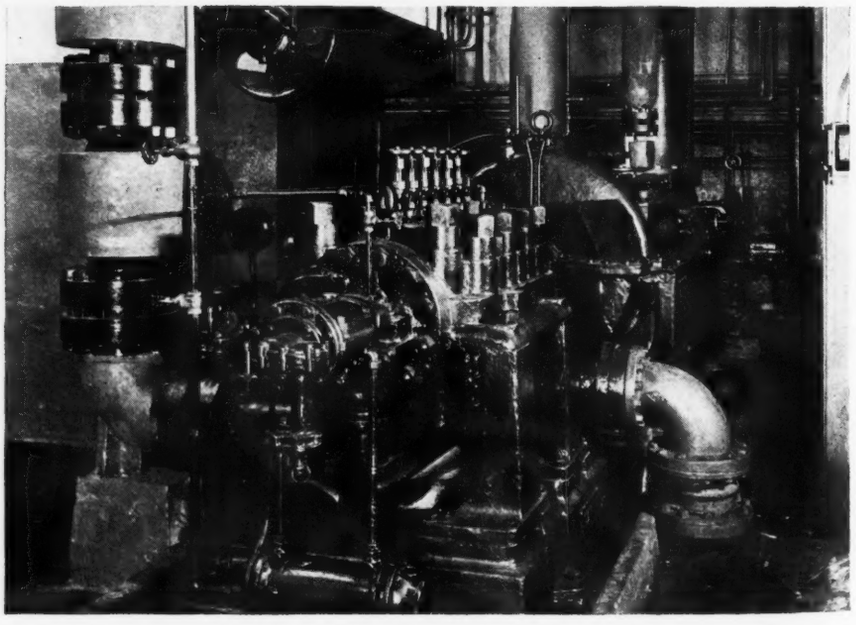


Fig. 3 (Right)—Six-stage emergency high-pressure boiler-feed pump driven by 1150-hp steam turbine in a large central station

0.0 to 14.0. A pH value of 7.0 is the neutral point, where a solution is neither acid nor alkaline. Decreasing values below 7.0 denote increasing acidity. Increasing values above 7.0 indicate increasing alkalinity in similar proportions. Any recent textbook on this subject may be consulted if a more comprehensive explanation of pH is desired.

In general, ordinary carbon steel or cast iron will be suitable for neutral or alkaline liquids. Bronze may be used in either neutral or moderately acid liquids; special alloys are required for solutions that are strongly acid. Recommendations made in the table will serve as a tentative guide in the selection of suitable materials for pumps to handle liquids at normal temperature.

This table is not a panacea for all pump-material recommendations. Each problem must be considered for possible abrasion by suspended solids, galvanic corrosion if the liquid is an effective electrolyte, effect of temperature if the liquid is hot, presence of dissolved oxygen, and the best commercial material when relative costs are considered. Any of these variables may change the recommendations in the table. For example, an acid mine water with a pH of 3.4 will be corrosive to bronze. Nevertheless, an all-bronze pump may be commercially best because of the much higher cost of special alloys. Then again, a liquid might be neutral, pH 7.0, and yet be corrosive to iron because of high temperature and the presence of dissolved oxygen. Or, it may be very corrosive to the iron parts of a regular-fitted pump if an appreciable concentration of salts makes the liquid an effective electrolyte. The table, however, serves as an intelligent starting point for selection of pump materials if proper consideration is given to these variables.

Three Important Factors

Every power plant is an individual problem with respect to corrosion and means by which it may be reduced or prevented. The three most important factors when selecting materials for boiler-feed pumps are temperature, pressure, and the water treatment. Effect on the pH value and the dissolved oxygen in the water makes water treatment doubly important. Where chemicals are admitted and whether continuously or intermittently are equally important.

Boiler-feed pumps handle water at temperatures ranging from 200 to over 400 F. Since the dissociation of water into hydrogen ions is greater with increased temperature it is apparent that the pH value of cold water will not indicate the hydrogen-ion concentration at the operating temperature. The curve taken from "Water Conditioning for High-Pressure Steam Generation" by R E Hall, shows this variation of the hydrogen-ion concentration with temperature and is based on data from the "International Critical Tables."

Temperature Changes pH

The curve shows that at 250 C (482 F) hydrogen-ion concentration is 25.8 times that of the same water at 25 C (77 F) and when expressed in the same terms as pH value (except for temperature) would be pH 5.6. The true pH value of the water is 7.0 as measured at 25 C (77 F). This is particularly important, because how corrosive a water is at high temperature depends on hydrogen-ion concentration rather than on pH value. This is true only at temperatures other than 25 C (77 F) because at this temperature hydrogen-ion concentration and pH value are both measures of the same characteristic under identical conditions.

Since pure water (pH 7.0) has a corrosive hydrogen-ion concentration at temperatures usually encountered in boiler-feed pumps, the pH value of feedwater must be higher than 7.0 to prevent serious corrosion. G Weyland, in May 21, 1938, *Die Wärme*, says that the pH value of boiler feedwater must be 9.6 or over if corrosion is to be substantially eliminated and that excessive wear in boiler-feed pumps is to be prevented by the use of corrosion-resistant materials.

Laboratory tests and field experience show that it is usually necessary to use corrosion-resistant materials, such as bronze and high-chromium and nickel steels, for internal wearing parts of high-temperature, high-pressure boiler-feed pumps where cast iron would ordinarily serve. This is because cast iron has a tendency to graphitize when subjected to corrosive conditions and it is not always possible to predict conditions where cast iron will graphitize.

MATERIALS FOR PUMP CONSTRUCTION TO HANDLE LIQUIDS HAVING DIFFERENT pH VALUES

pH Range	Materials for Construction
Under 3.5	Corrosion-resistant steels
3.5 to 6.0	All bronze
6.0 to 8.0	Bronze, iron or regular-fitted[1]
Over 8.0	All iron or steel

[1] A regular-fitted pump is a combination of bronze and iron parts. Usually the impeller and some of the rotor parts are bronze and the casing is cast iron.

For these reasons it is essential to know the pH value of the feedwater in order to select suitable materials for the boiler-feed pump. Unfortunately, in many instances, it will be difficult, if not impossible, to obtain a reliable pH value. In some cases, the pump is for a plant not yet in operation. Then the pH value should be estimated on the basis of similar stations and proposed method of treatment. Failing this, it is necessary to know the proposed method of feed treatment, including how and where the chemicals are injected, what plans have been made for deaeration, and the temperature of the feedwater.

In plants which already are operating it will usually be equally difficult to secure a reliable pH value of the feed water. Station operators are primarily concerned with protection of the boilers and turbine. To do this it is customary to control the pH value of the boiler water between 9.5 and 11.5, the exact figure depending on the kind of treatment and operating conditions. At pH values lower than 9.5, corrosion may be excessive and at pH values higher than 11.5 there is some danger of caustic embrittlement.

Determination of pH Values

For determining the pH value of the boiler water most operators use some form of color comparator, entirely satisfactory for determining the pH value of boiler water, raw water or similar solutions, that are buffered by dissolved solids to an appreciable extent and so resist change in pH value. The feedwater in central stations, almost free from dissolved solids, is usually completely unbuffered and extremely susceptible to change in pH value. Its pH value can be lowered by absorption of carbon-dioxide from the air and an error of as much as two full pH units can occur due solely to adding an indicator solution of a lower pH value than the water sample.

Errors of the colorimetric test can be eliminated by using iso-hydric indicators, but this procedure is not suitable for routine or control work where speed is essential. Various suitable electrometers are available, however, by which accurate determinations of the pH value of unbuffered solutions may be obtained.

Unfortunately, obtaining a true pH value of feedwater is not all there is to selecting suitable materials for the feedwater pump. To maintain a definite alkalinity in the boiler water requires addition of suitable chemicals, usually alkaline. When these are put into the boiler, or discharge of the boiler-feed pump, the pH value of the feedwater

may be considered as representative of normal conditions.

When, however, chemicals are injected continuously on the suction side of the pump, pH value of the feedwater will vary over an appreciable range because the quantities of chemicals are varied according to conditions shown by the boiler water analysis. When batch treatment is used, the chemicals required by the boiler water are injected rapidly, usually every 8 or 24 hr. This causes an abnormally high pH value 1 to 3 times per day for intervals ranging from 15 min. to 2 hr.

Feedwater Conditions

When all these factors are known, pump material recommendations can be made on the basis of present feedwater conditions. However, there is no assurance that present conditions will exist in the future. Rapid progress is being made in boiler-water control to prevent scale and corrosion. These changes may be desirable for the boilers and turbines but it is possible that they may be unfavorable for the boiler-feed pump. Condenser circulating-water leakage may affect the pH value of boiler feedwater. When the condenser circulating water is acidic (under pH 7.0) it may constitute a serious corrosion hazard to boiler-feed pumps and other parts of the equipment if leakage occurs. Condenser circulating water has been known to have a pH value as low as 3.8.

If feedwater contains an appreciable amount of carbon-dioxide the pH value may be as low as 5.6, which is highly corrosive. The use of sodium-carbonate (soda-ash) for maintaining the desired boiler-water alkalinity can cause such a condition. Cases of this kind are on the decrease since the various phosphates of sodium have come into widespread use.

When the pH value of the feedwater is known to be lower than desirable, it is not uncommon to recirculate some of the boiler water to raise its pH value and thus protect the auxiliary equipment. Some station operators object to this practice, but this objection is gradually being overcome as more of the organizations specializing in water treatment permit and even sponsor the practice.

No discussion of feed-pump materials and corrosion is complete without mention of dissolved oxygen, which is next in importance to the pH value, because of its effect on the rate of corrosion, particularly of iron and steel. Dissolved oxygen in any quantity is definitely corrosive to these materials. This gas can be, and usually is, practically eliminated by use of suitable deaerators. Such treatment, in addition to removing the dissolved oxygen will eliminate any carbon-dioxide that may be dissolved in the condensate. In many plants any residual dissolved oxygen in the feedwater is eliminated by adding a suitable chemical, usually sodium sulfite or sodium hydroxide and ferrous sulfate. These chemicals will only protect the pump from corrosion by residual oxygen when they are fed continuously to its suction, and injected at a sufficient distance from the pump to permit intimate mixing with the water before it enters the pump.

When the condenser has a deaerating hot well and the deaerator heater is omitted, condensate pumps must be free from air leaks. Poorly maintained condensate pumps have been known to admit sufficient air to raise the oxygen content of the condensate from a satisfactory value to an extremely hazardous one.

From the foregoing it is evident that for a manufacturer to make a reliable recommendation of materials for high-pressure, high-temperature boiler-feed pumps, the operator must guarantee to maintain a pH value within certain limits and provide effective deaeration, or corrosion-resistant materials must be used for the wearing parts of the pump. Corrosion-resistant materials are much more expensive than ordinary iron or steel which will frequently be satisfactory if stated operating conditions can be maintained.

Industrial-Plant Problems

Feedwater-pump problems in industrial plants are quite different from those in central stations. In industrial power plants feedwater is frequently raw water, softened by treatment. The pH value of the treated water is frequently as high as 9.0 or 10.0 and the operator's tests of it are reliable because the water is appreciably buffered. At these high pH values, bronze parts, which at lower pH values ordinarily resist corrosion better than iron or steel, frequently fail prematurely by caustic corrosion and ordinary iron or steel parts are satisfactory.

Because of the high pH value of the feedwater, excessively high boiler-water alkalinities frequently result and it is not uncommon in industrial power plant practice to put an acid salt into the boiler to reduce the alkalinity. These acid materials are frequently put in on the suction side of the boiler-feed pump where they cause a large drop in the pH value of the feedwater and make the water severely corrosive to iron and steel. Cases are on record where this treatment reduced the pH value from a safe 9.3 to an extremely hazardous 1.9 during the injection of sodium bisulfate. At this low pH value, feedwater attacks steel rapidly, with hydrogen evolution even at room temperature.

Deaeration of Feedwater

It is not unusual in industrial plants, because of overloading the deaerators or from too low a temperature in the open heaters, that deaeration is not complete. Also certain types of water treatment which, when not properly applied, may produce carbonate or phosphate deposits in the feed lines and sometimes in the pumps. This is a water-treatment problem rather than a pump problem and can be corrected only by the operator.

Even though the feed-pump problem in industrial power plants may be entirely different from that in central stations, it is equally important to have available complete information on the feedwater and its treatment. The pH value and any pertinent information concerning present pumps in identical service is of value in the selection of proper materials for the pumps.

The author wishes to express his appreciation to A H Richards, Field Engineer, Cameron Engrg Service Dept, Ingersoll-Rand Co, for his assistance and many helpful suggestions.

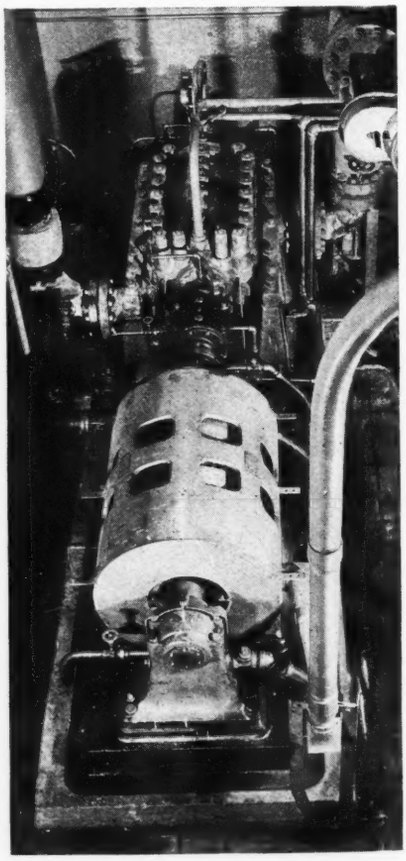


Fig. 4—One of two 5-stage 1600-lb boiler-feed pumps connected to a 1250-hp motor

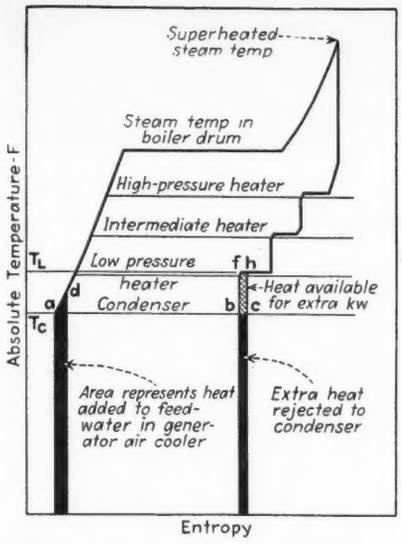


Fig. 1—Area at left represents heat picked up in air cooler. At right, shaded areas show part of heat goes to making extra power, remainder is rejected to condenser

Generator Coolers Save Bleed Steam

Here is a simple formula for calculating net heat saving from use of condensate in generator air coolers

By W G BLAKE
General Electric Co

THERE ARE TWO WAYS of connecting generator air-cooler banks to recover generator heat losses in closed-air-circuit systems. Two separate banks can be used, one operating on condensate and the other on raw water, or a single bank can be connected to both raw-water and condensate supply with suitable valve arrangement. The former is flexible but costs more. The latter usually requires that only raw water be used in the summer when high water temperatures prevail but initial cost is little more than for a simple raw-water cooler.

The calculation of net heat saving means figuring small differentials in turbine heat rate. Ordinary methods of evaluation do not give very reliable results. However, a generalized equation can be obtained from analysis of the temperature-entropy diagram and quickly applied to most cases.

Fig. 1 is a temperature-entropy diagram showing a regenerative cycle having three stages of bleed heating. Areas on this diagram represent heat quantities per lb of steam, or, more convenient for the present case, heat quantities flowing per hour. The diagram has been distorted to bring out more clearly the low-grade heat quantities involved.

If there is available a quantity of heat, H, from the generator air coolers for feedwater heating, it may be used to raise the condensate temperature from a to d. This low-grade heat decreases the quantity of heat extracted from the lowest-pressure bleed point by an equal amount as represented by the shaded areas under fh.

This is equivalent to saying that transferring the heat ad to the feedwater decreases the amount of bleed steam by a small amount, and the difference goes through the last-stage wheels to produce added power, represented by the area $fhcb$ and an added amount of heat to the condenser equal to the shaded area under bc.

An equation can then be set up as follows:

$$E = H\left(\frac{T_i - T_e}{T_i}\right)$$

where E = Increase in available energy due to recovery of low-grade heat
H = Heat available from generator air cooler
T_i = Absolute temp at 1-p extraction stage
T_e = Absolute temp at condenser

The value of available energy increase given by this formula is theoretical and must be corrected when applied to an actual machine because of changed conditions in the low-pressure section of the machine. Due to increased condenser flow, the low-pressure extraction pressure will be raised slightly, but the resulting effect is small and can be neglected. The effect of leaving losses, however, must be taken into account as they are an appreciable proportion of the energy involved.

If a curve of leaving loss for the particular turbine is at hand, the amount to be subtracted from E is:

$$\frac{H \times L}{H_L}$$

where H_L is the enthalpy at the low-pressure extraction point and L is the leaving loss in Btu per lb corresponding to the condenser flow being considered. In addition there is an increase in the leaving loss applying to the whole condenser flow: $dL \times F$, where dL is the increase in leaving loss due to the increased flow and F is the total condenser flow.

Calculations made on several machines from 20,000 to 45,000 kw indicate that the total leaving-loss effect is about 40% of E at rated flow. For a first approximation or if leaving-loss curves are not available, this figure can be used. Only if exhaust areas are of unusual proportions will this figure change considerably.

Knowing the extra heat available to work (dividing by 3412 to find theoretical added kw output) it is easy to determine whether cost of a condensate section is justified. Actual increase in output is about 80% of the theoretical value determined above to account for over-all unit efficiency. The result is increased power output of the unit as nothing has been changed as regards the amount of heat added from the boiler.

The increase in output varies with load. The calculation can be made for an average load or for several points as the scheduled operation may indicate.

LET *us be thankful for the fools. But for them, the rest of us could not succeed.* —Mark Twain

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THE *highest and most lofty trees have the most reason to dread the thunder.*—Charles Rollins

Wood-Stave Pipe Repaired Under

By LOUIS C MOORE, *Mechanical Engineer, Ishpeming, Mich.*

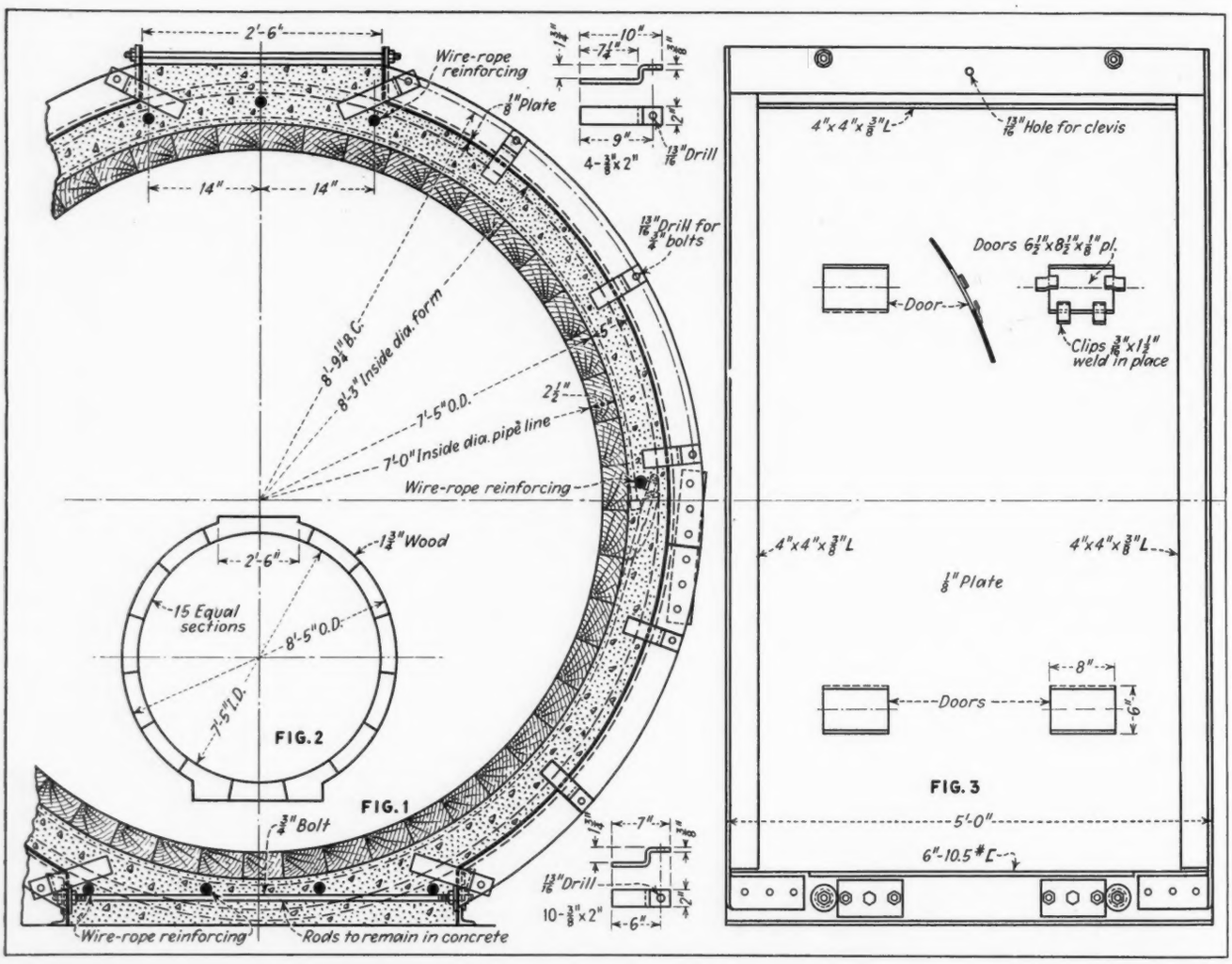


Fig. 1—Form in place on wood-stave pipe ready to pour concrete. Fig. 2—Wood shapes for inclosing ends of steel forms when in place on pipeline. Fig. 3—Elevation of one of the concrete forms constructed of steel plate and shapes

SOME ENGINEERS still believe that the only way to stop leaks in partially decayed wood-stave pipeline is to shut down the hydroelectric plant and replace the decayed section with new pipe. Such a repair is costly and a standby plant may not be available to replace the one shut down. Plant owners can now, however, repair wooden pipelines while they are in service.

D McClure, manager, Cliffs Power and Light Co, Ishpeming, Mich., developed a simple method of making such repairs on a wood-stave line over 1 mile long and 7 ft in diameter, serving one of 6 hydroelectric power plants operated by his company. This method incases the defective sections of the pipe in reinforced concrete while the line is under normal pressure.

When the pipeline was built in 1918, it was covered with sand as a protection against frost and forest fires. After 20 years' service, when small leaks showed that the wood was partially decayed, the pipe was uncovered and inspected. This showed that the worst decayed section carried less than 20 lb per sq in. pressure and was between the surge tower and a railroad crossing. It was feared that the pipeline might fail in this section and wash out the railway line; therefore, first repairs were made on this section, 306 ft long. Fig. 1 shows the sectional steel forms in place around the pipeline and Fig. 3 gives details.

Twelve sections of semi-circular steel forms were built. These forms were made to a length that would meet within 4 ft at top and bottom of the pipe, as in Fig. 1. Each was constructed of 2 angles curved on a 50-in. radius, and with steel plates on their inner surface to form sections 5 ft long. A 6-in. channel at top and bottom end of the angles completed the forms. Two 1-in. holes were bored in each channel for ¾-in. bolts to hold the forms in place. When forms were in place, space between them and the pipe was inclosed by 1¾-in. wood section, Fig. 2, held in place by metal cleats bolted to the angles, holes having been bored for this purpose.

Pressure

A caterpillar crane did the heavy work, such as removing the sand covering from the pipe and handling the forms and concrete. After removing the sand covering from the pipe, it was brushed clean and all decayed wood removed. The crane then picked up the 5-ft steel form sections and placed them in position on each side of the pipe, while the workmen adjusted them in position, inserted and tightened the bolts. Each form for the concrete comprised two 5-ft sections 5 ft long, to give a total form length of 10 ft along the pipe.

After base channels were adjusted, the ¾-in. tie rods were put into place and nuts tightened onto the channels, giving the forms a stiff support. When the forms were in place and adjusted to give 5-in. space between them and the pipe, 30-ft pieces of discarded crucible-cast-steel mine-hoist rope were wrapped around the pipe on 10-in. centers. These were allowed to rest against the steel form with their ends overlapping about 4 ft. Other sections of this rope were placed lengthwise of the form, 4 at the bottom, 3 at the top and one on each side, as in Fig. 1. This wire rope was obtained from a nearby iron mine, at scrap price, but it had ample strength for reinforcing.

Some concrete authorities claim that wire rope will deteriorate and rust away when buried in concrete, but old wire rope used to reinforce a concrete water tank showed no bad effects after being in the concrete for 25 years.

After the sections of wire rope were in place, the ends of the form were closed by wood sections, Fig. 2. These sections were held in place by flat steel cleats bolted to the angles. Concrete used was of 1–2–3 mixture and mixed in a 5-bag machine. A bucket large enough to hold the batch was handled by crane to pour the concrete into the top of the forms.

To insure dense concrete and a smooth job, lower doors of the form were opened and the workmen tamped the concrete around the pipe until the form was filled level with the bottom of the doors. Form was also tapped with hammers to settle the mixture. When a form was filled up to the lower doors, these were closed and tamping operations carried on through the upper doors. After these could no longer be used, the job was finished through the top of the form.

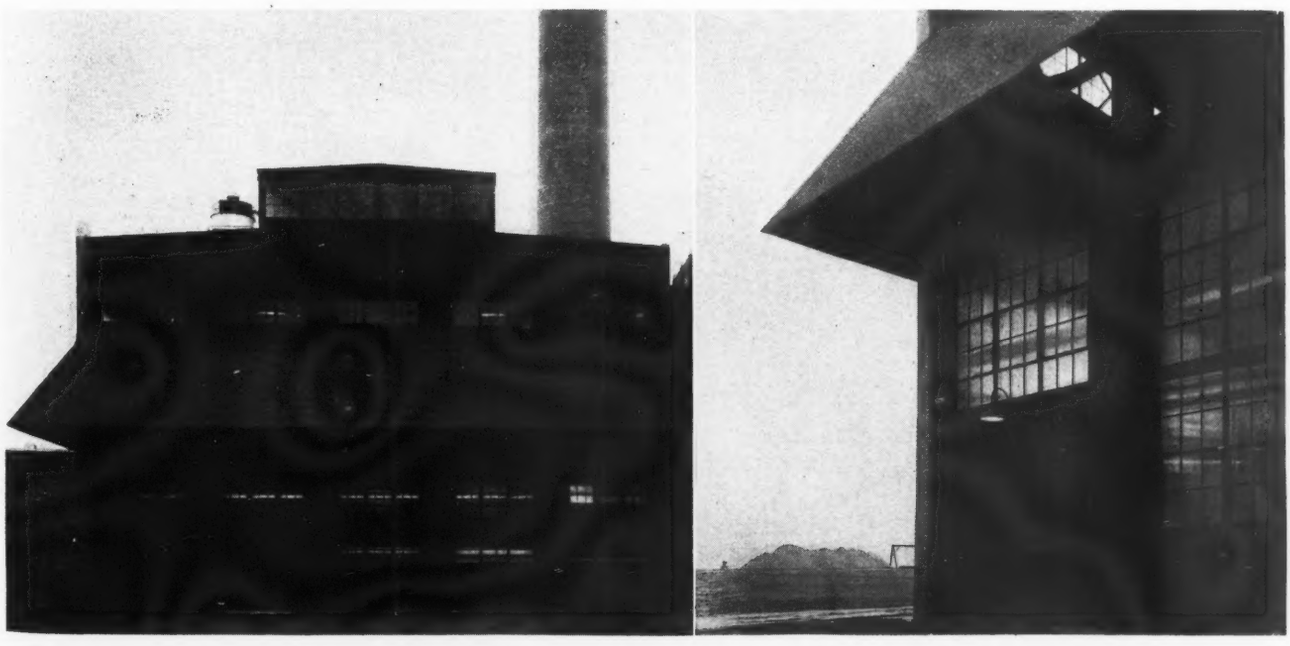
A crew of 1 foreman and 11 men could set up a 10-ft section of form, mix and pour the concrete in an 8-hr shift. The next day, 10 ft more could be poured and similarly on the 3rd day. On the 4th day, forms on the first 10-ft poured were removed and reset. Thus, 3 days were allowed for the concrete to set, which was ample time for it to harden.

This method of repair was first applied 6 years ago on a 60-in. line of the company's Carp River hydro plant. Yearly inspection of this pipe's interior has failed to show signs of changed condition since being incased in concrete and the pipe gives evidence of lasting indefinitely.

Average cost of concreting 1328 ft of the 7-ft line was $13.46 per ft. This included all labor and supplies. The work is being continued this year with length of forms increased from 5 to 6 ft, which will permit pouring a 12-ft section of concrete at one time. The work is to be continued each year, repairing the sections of pipe that are in the worst condition until the line has been incased.

✦ ✦ ✦

Canopy Ventilates Boiler House



Pictures show unique design for boiler house ventilation at St. Joe Paper Co's plant, Port St. Joe, Fla. Canopy takes place of horizontal band of wall on three sides of building; construction gives unusual amount of free space for air passage but protects against wind and rain. On day pictures were taken, editor found interior unusually comfortable for a boiler room in the semi-tropics

Power Serves Process

Ingenious turbine controls hold constant pressure on exhaust and extraction, and at the same time serve power needs

By S H HEMENWAY
Westinghouse Electric & Manufacturing Co

A BYPRODUCT-POWER steam-turbine control can be arranged so that the turbine not only automatically furnishes steam at required pressure and quantity for process, but may also be available to take care of electrical load demand.

The diagram, Fig. 1, is typical of installations made in several Southern paper mills for such special conditions. Steam from the high-pressure boiler is admitted to the turbine in the usual way through a multi-valve steam chest under control of the first-stage governor and steam-chest operating mechanism. This steam is expanded part way through the turbine to an intermediate stage from which some of the steam is extracted for process. Steam flow from this intermediate stage to the exhaust is controlled by a similar multi-valve steam chest under control of a similar operating mechanism. The turbine exhausts to a low-pressure process line.

Fig. 2 is a cross-section of this type of turbine. The high-pressure steam is expanded through a Rateau (single-velocity) stage and several reaction stages to the high-pressure extraction point. From this point to exhaust, a Rateau stage and further reaction stages are employed. The picture shows the solid rotor construction, self-contained hydraulic governor and steam-chest valve-operating mechanism, and plug-type steam-chest valves which, on turbines that extract at relatively high pressures, are used at the extraction point as well as in the first-stage chest. At low extraction pressures, a multi-port grid valve can be used to control steam flow from extraction stage to exhaust.

Referring to Fig. 1, the exhaust-pressure regulator controls the opening of the second-stage steam-chest valves to supply sufficient steam to maintain desired pressure in the exhaust line to the mill. The extraction-pressure regulator controls the opening of the first-stage steam-chest valves to admit sufficient flow to take care of exhaust-steam demand and to maintain extraction pressure. The turbine usually operates in parallel with a tie-line which maintains frequency and carries electric load in excess of that which can be generated as a byproduct of the process-steam demand.

A load regulator is used on the incoming connection from the tie-line. When the power taken from this line exceeds the value for which the regulator is set, it energizes a motor-operated valve, releasing steam from the

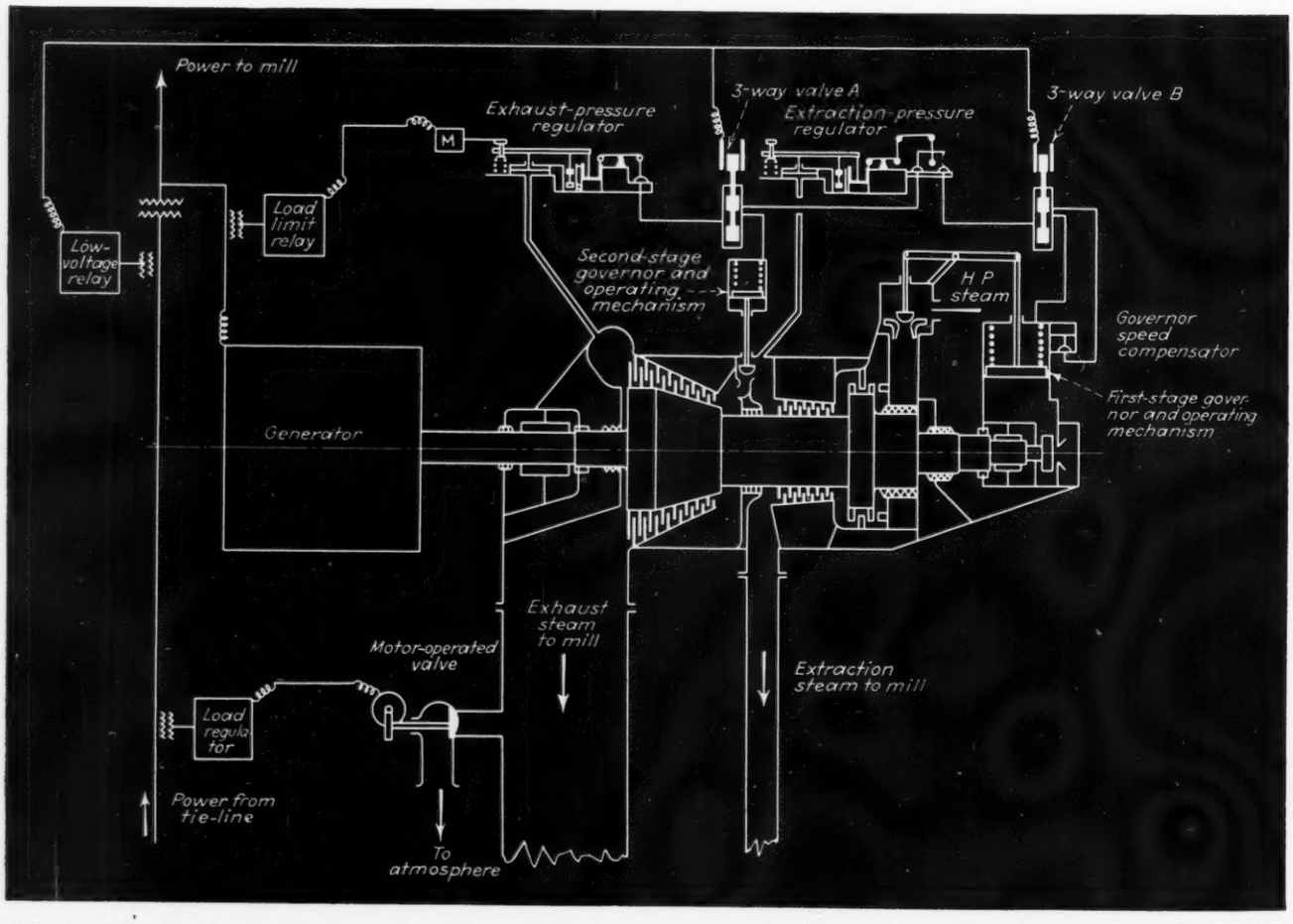


Fig. 1—Exhaust and extraction-pressure regulators control normal steam flow. Speed governor holds frequency when needed

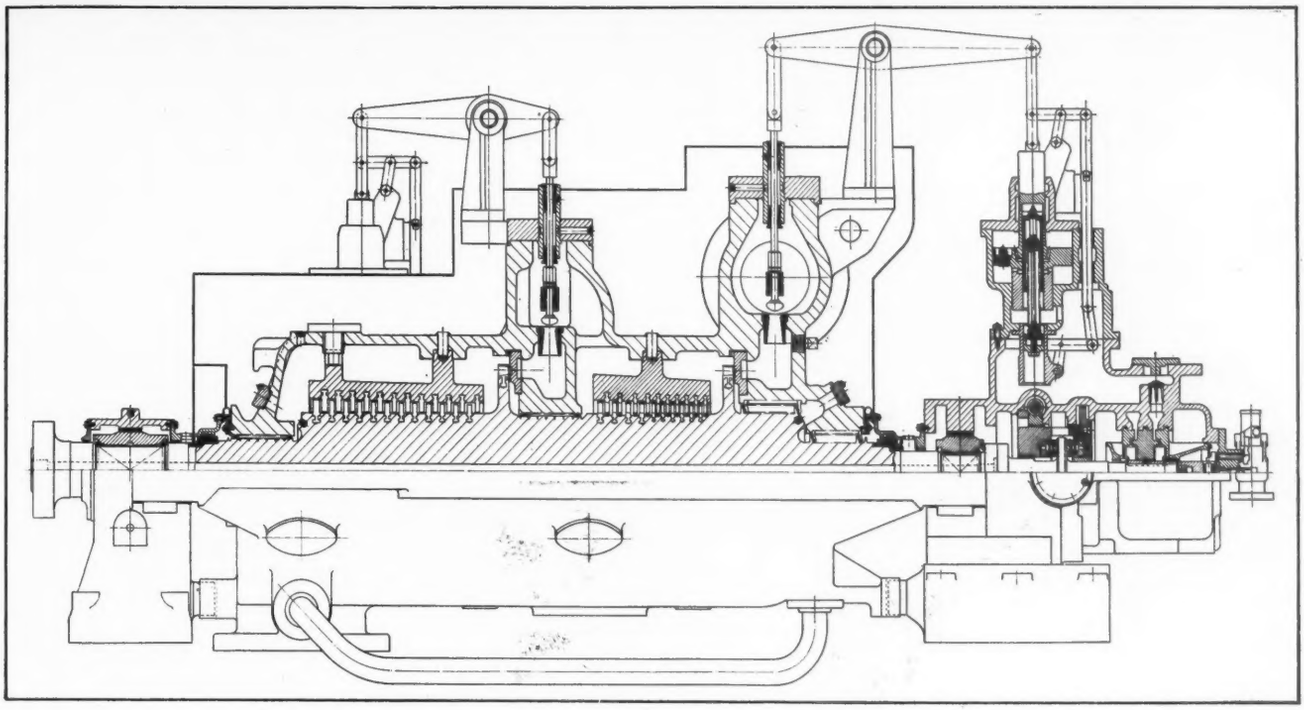


Fig. 2—Cross-section of automatically regulated extraction-backpressure turbine

exhaust line to atmosphere. This creates a temporary artificial demand for steam in the exhaust line, so that the turbine passes more steam and generates more load, thus keeping the power taken from the tie line within set limits. It is more economical to exhaust some steam to atmosphere over short periods, than to set up a new maximum demand on the tie-line or to provide greater capacity on that line to meet short-period peaks.

In case of an interruption to the tie-line, it is necessary to regulate turbine speed to control frequency on the line. rather than as a byproduct power unit floating on the line. In case of failure of power on the tie-line, the low-voltage relay operates the 3-way valves *A* and *B* to transfer the unit from byproduct-power generation to speed-responsive control. After the transfer. speed variation is held within close limits by the governor-speed compensator.

Steam pressure at the extraction point is controlled by the extraction regulator. There is no control of the exhaust-steam pressure, as one of the otherwise controlled quantities must now be left free to vary in accordance with load demands to maintain frequency. In some cases, operation of the low-voltage relay is made to disconnect the non-essential plant load when this is necessary to reduce the total load to the limits of the plant turbine-generator.

When the low-voltage relay operates. it causes the plunger of the solenoid-operated 3-way valve *A* to move upward, thus bringing the second-stage steam-chest-operating mechanism under control of the extraction-pressure regulator instead of control by the exhaust-pressure regulator. At the same time, it causes the plunger of the solenoid-operated 3-way valve *B* to rise, thus bringing the first-stage valve operating mechanism under control of the governor speed compensator instead of the extraction pressure.

A load-limit relay may be used in the generator terminals to reduce the setting of the exhaust-pressure regulator when demand for steam at the two extraction points are such as to overload the generator.

Exhaust Lines

By L N ROWLEY

Where would *you* expect to find the world's largest mechanical stoker? Probably almost anywhere but China. However, it looks as if the palm for size goes to the 756-sq-ft traveling-grate unit soon to be shipped to the Hok-Un Station, China Light and Power Co, Hong Kong, by International Combustion Ltd. This stoker, to burn a range of semi-anthracite coals, will fire a 200,000-lb-per-hr boiler.

Spent a highly interesting afternoon with Lloyd Beall, in charge of the Steamotive unit at Ford's Northville plant. All the operators like this unit and the record indicates they have good reason—only three short outages in last 10 months and none directly chargeable to the equipment. At best load, unit will produce a kwhr for 0.96 lb of Bunker C oil; consumption only rises to 1.2 lb at worst load. As soon as possible we're going to bring to POWER readers a complete story on operating experiences with this unique plant.

Last year the British electrical "grid" was in operation throughout the country for the first time. Stations generating for the Central Electricity Board now produce 97.2% of the national output. Capital saving to the industry is estimated at about $100,000,000 (to the end of 1938). Economies from interconnected operation lowered cost per unit generated 24% from 1932 to 1938. Estimates place the actual saving to the industry above $40,000,000 a year.

A simple request from a little girl in the Bronx, New York, recently floored General Electric's seldom-stumped engineers—we quote her postcard: "Will you kindly send me some booklets and a little sample of electricity, if you can spare it. We are studying about it in geography".

Ejectors Beat Air Pumps

When hydraulic air pumps eventually grow too old, replace with low-cost air ejector. It has no moving parts

By J P LIDIAK
Westinghouse Electric & Manufacturing Co

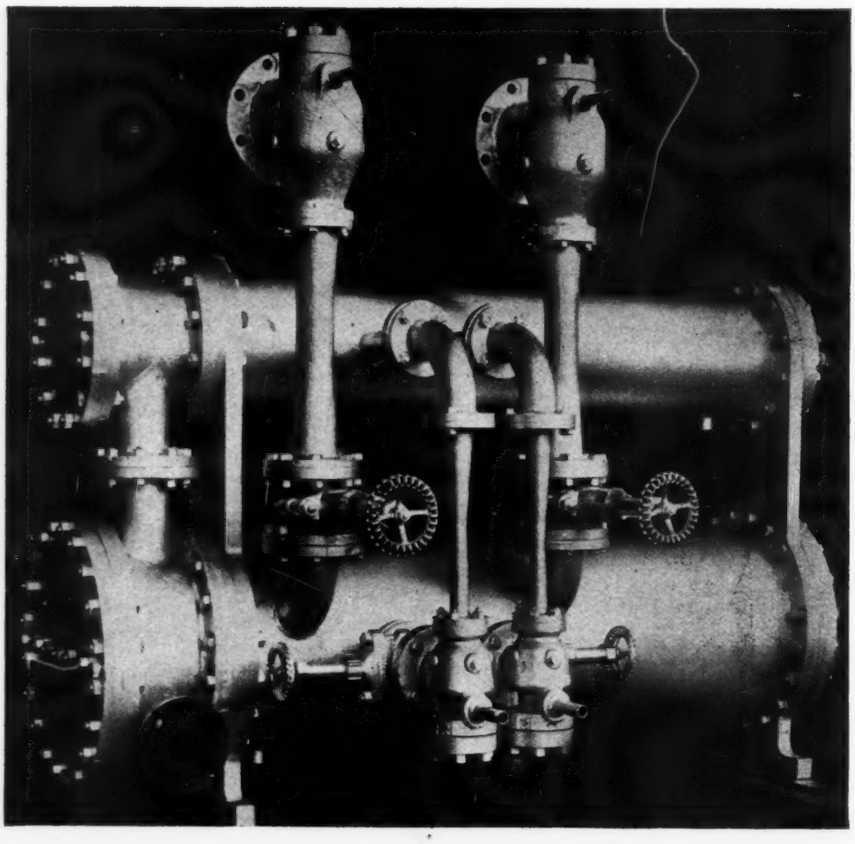


Fig. 1—A modern steam-jet air ejector has no moving parts and practically all heat used can be recovered

THE FIRST STEAM-JET air ejectors built in this country for commercial use were non-condensing and their application was more or less limited. A few years later, condensing air ejectors were introduced. They were well received by power-plant designers and operators and shortly became the standard air-removal apparatus. Fig. 1 shows a modern air-ejector unit with surface-type inter-after condensers.

It is now common practice to replace old air pumps with air ejectors because:

(1) An air pump is rotating or reciprocating machinery and wear on some parts may be excessive, contributing to high maintenance cost. An air ejector is a static piece of machinery and maintenance is low since only the steam nozzles and perhaps tubes in condensers are subject to wear.

(2) Most air pumps have been in service fifteen years or more and patterns for necessary repair parts may not be available. New patterns and parts often cost as much as a complete ejector unit.

(3) The thermal efficiency of an air-ejector unit is high. By circulating make-up or condensate through intermediate and after condensers it is possible to recover practically all the heat from the steam. Substitution of an air-ejector unit for an air pump can readily be justified for a majority of plants. Conditions, however, vary and no general comparison can be applied to all cases. It, therefore, is desirable to consider each case separately.

(4) Old air pumps, particularly

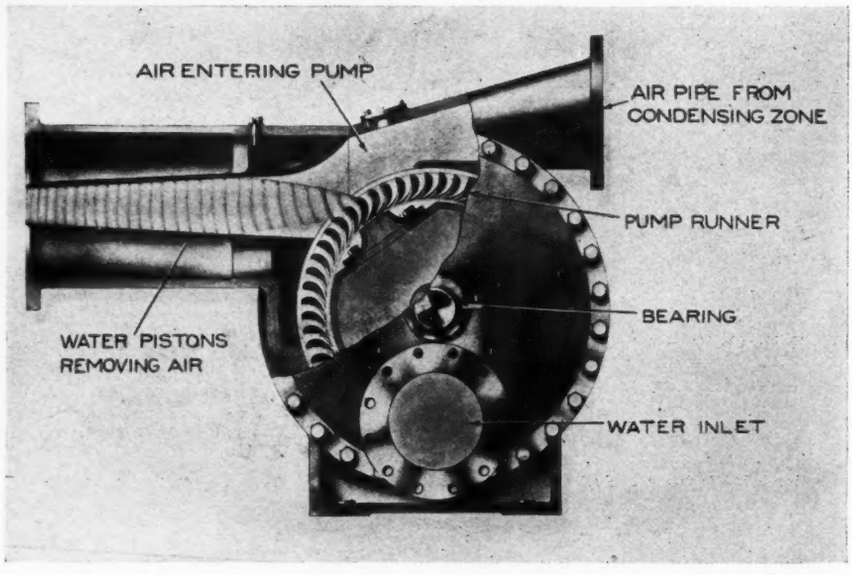


Fig. 2—Diagrammatic view of Le Blanc air pump

those serving surface condensers, are usually oversize as the importance of reducing air leakage to a minimum was not generally appreciated at the time some of the older units were installed. Power required by a rotative pump is practically constant regardless of the amount of air handled. On the other hand air-ejector units consist of multiple elements and it is possible to operate only the number required to handle the actual air leakage.

(5) It is a simple matter to install an air meter in the vent line from an air ejector unit. This provides a check on air leakage and an incentive to keep it within reasonable bounds.

Prior to the introduction of air ejectors, various designs of hydraulic air pumps served both jet and surface condensers. The Le Blanc air pump manufactured by Westinghouse belongs in this class and Fig. 2 shows a diagrammatic sectional view. A pump of this design requires water in considerable quantity which, within limits, condenses any exhaust steam which may find its way from the condenser into the air-vapor outlet pipe. With such a pump the problem of air cooling is eliminated to a great extent.

Curves in Fig. 2 give the amount of vapor per pound of air at various temperatures and absolute pressures. An air ejector can handle a certain weight of air-vapor mixture at a given absolute pressure. The lower the temperature of the mixture the greater can be the amount of air removed from a condenser by an air ejector. When an air ejector is being applied to an old condenser, it is important to consider the

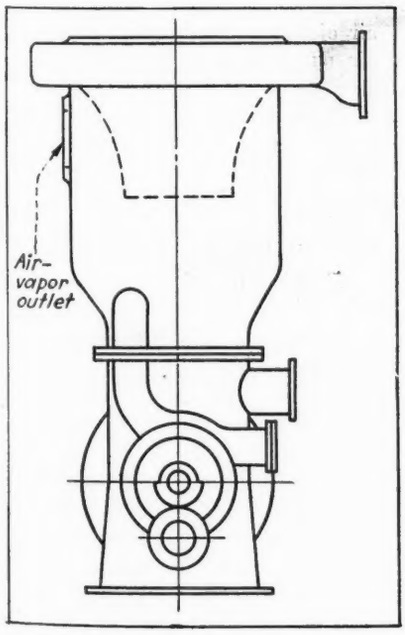


Fig. 4—Air jets suit low-level-jet and barometric condensers too

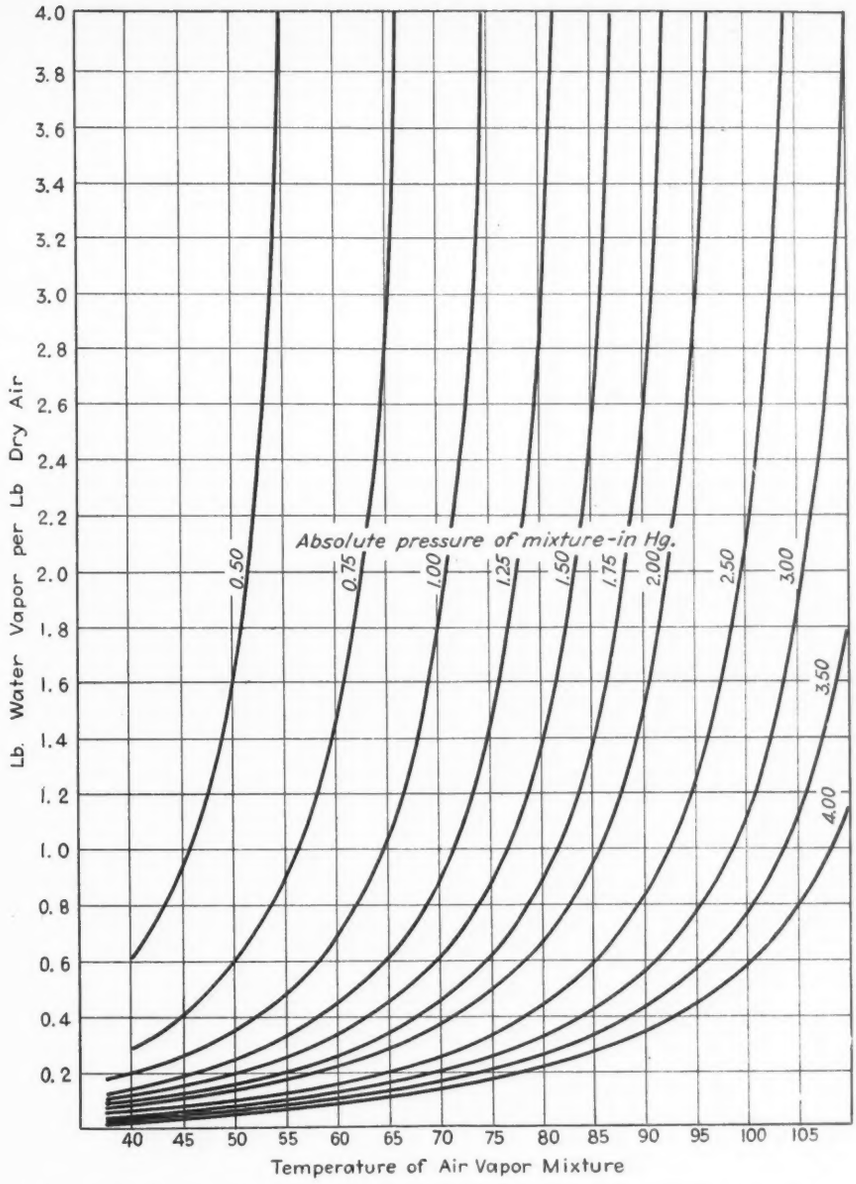


Fig. 3—Temperature of air-vapor mixture affects quantity of mixture removed

following: (1) Possibility of short circuiting exhaust steam into the air-vapor outlet pipe. (2) Probable temperature of the air-vapor mixture and possibility of cooling it.

Air ejectors are no "cure-all" for low vacuum. Substituting air ejectors for an air pump will not improve vacuum in a condenser unless the latter is not functioning properly or unless the air leakage is excessive and an air-ejector having higher capacity than the air pump is installed.

Fig. 4 shows a typical low-level jet condenser with the air-vapor outlet located under the cone. The cone insures proper commingling of exhaust steam and water and thus all the steam is condensed. Under such conditions there is no danger of steam flowing into the air-vapor outlet pipe. The temperature of the air-vapor mixture approximates that of the discharge water. An air ejector for jet condensers is relatively large as it must handle not only the air-leakage but also the air contained in the cooling water.

Most such units are equipped with jet intercoolers and thus the heat from the steam used by the first stages is not recovered. From an efficiency standpoint, the air-vapor mixture should be at a comparatively low temperature and a precooler is nearly always installed between condenser and ejector. This is usually a small barometric condenser, water for which is taken from the condenser supply line. This water is drained back into the condenser for removal with the outlet water.

For a barometric condenser, the jet chamber is similar to the one shown in Fig. 4 and the air ejector application is similar. If an air cooler was originally furnished no change need be made. It is, however, important to con-

sider the possible danger of short circuiting steam into the air-vapor pipe.

Fig. 7 shows a surface condenser used with the old type of wet air pumps. Usually no internal baffles were provided and it is evident that some exhaust steam reaches the bottom of the shell. This steam, however, is finally condensed by the condensate and does not reach the air-vapor outlet pipe located on the side of the hotwell. In a condenser of this design the temperature of the air-vapor mixture approximates that of the condensate. Ejector capacity is usually based on the actual capacity of the old air pump. In some cases it may be economical to install a precooler. Such a precooler may be either jet or surface type.

The design shown in Fig. 6 has been used extensively in the past. An internal air cooler is provided, the air-vapor entering the cooler portion under the baffle along the entire tube length. When an air ejector is to be substituted for an air pump on this type of condenser, give consideration to the following:

(1) To prevent short circuiting of exhaust steam into the air-vapor outlet, have all baffle joints tight between the condensing zone and the space isolated for air-vapor cooling.

(2) The original baffle may be corroded through in sections and a new baffle may be required.

(3) The amount of surface under the baffle may not be sufficient to insure proper cooling of the air-vapor mixture. Furthermore this surface may not be arranged properly as there may be some restrictions at the entrance. Changes in the baffle and cooler are desirable in such cases.

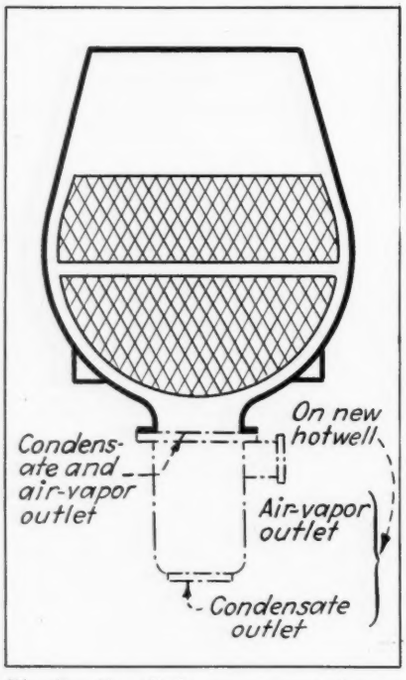


Fig. 7—Air offtake arrangement for radial-flow condenser

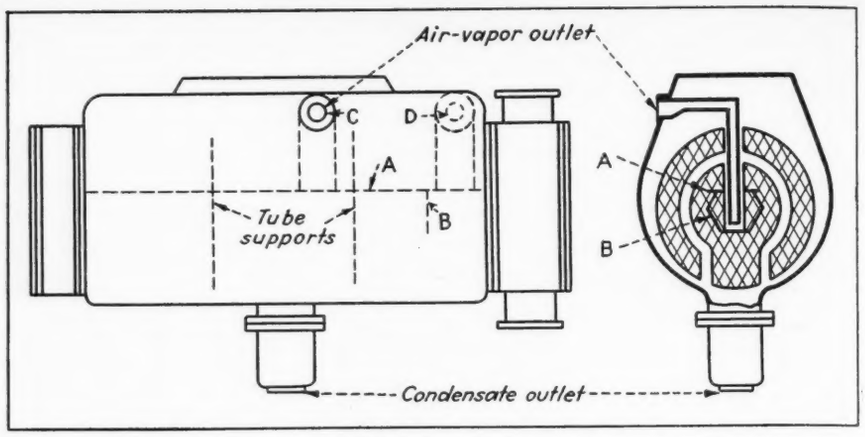


Fig. 5—Adding new hotwell and air ejector improves performance

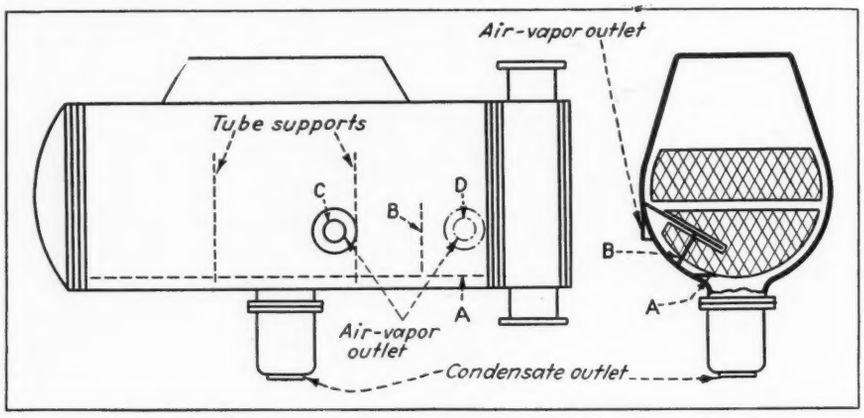


Fig. 6—Baffle changes assure low-temperature air-vapor mixture

(4) Practically all of these condensers have cast-iron shells and irregularities in the castings may leave gaps between tubes and shell. Such a condition on the baffle side may permit flow of steam into the air-vapor outlet pipe. To prevent this, one or more deflector strips "A" as indicated in Fig. 6. are installed. These strips must extend the entire tube length.

Fig. 5 shows a radial-flow condenser in which the air box, extending the entire length, is located approximately at the center of the tube nest. In some cases it is desirable to change the approach to this box and add baffle "A." Reasons and explanations given above under 1, 2 and 3 also apply.

To make the changes described above, the tubes must be removed from a condenser. Such procedure is at times out of the question so that when a condenser is to be retubed and substitution of air ejectors for air pump is being considered, the various points should be kept in mind.

It is also desirable to rearrange the air-vapor outlet so that the removal of the mixture is accomplished at the water-inlet end. Changes in the locations of these outlet openings from "C" to "D" are shown in Figs. 6 and 7. When such a change is made a transverse baffle "B" under the main baffle should be provided between the newly located air-vapor offtake and the adjacent tube support.

No general statement can be made favoring an external air cooler when an air ejector is being substituted for an air pump. It is best to treat each case separately. If all the above changes are made there is no further need for an external air cooler.

Unless otherwise specified, the actual capacity of the existing air pump is the basis of determining size of air-ejector unit. This procedure is sometimes modified to suit conditions. As already pointed out, some existing air pumps were too liberal in capacity.

When propositions are requested on air ejectors to replace reciprocating pumps it is necessary to have displacement and volumetric efficiency of the pump. Displacement can be calculated if length of stroke, bore of air cylinder, number of strokes per minute, single or double acting, and whether single or compound are known. Obviously the vacuum desired and temperature of the air-vapor mixture should be ascertained before making the substitution.

How Much Wear in Coal-Dust Engines?

By C H S TUPHOLME

EACH EUROPEAN nation's campaign for self-sufficiency includes development of home-produced fuels. This is particularly true in Great Britain where research workers at H M Fuel Research Station, Greenwich, study, under government auspices, potential domestic sources of fuel and improvements in preparation and use. At present, work is going forward on an investigation of the practical possibilities of coal dust as a fuel for internal-combustion engines.

Diesel designed his cycle for coal dust but ran into practical difficulties, as have all other engineers who attempted similar designs. Ash in coal causes the trouble—during expansion and exhaust strokes, part of ash and possibly carbonized or unburnt particles of coal come into contact with and adhere to the lubricant film on the cylinder walls, forming an abrasive paste that soon wears liners, pistons, and rings. Experiments now under way at the station point toward reduction of wear to a practical level by suitable combinations of materials.

How Tests are Run

Test procedure is quite simple: coal ash is injected at a constant rate into the carburetor intake of a single-cylinder gasoline engine running on gasoline under controlled conditions of load and speed. Investigators measure liner, piston, and ring wear at intervals. Three identical engines have been used for these tests; each is an overhead-valve, water-cooled single-cylinder unit, of 3⅜-in. bore and stroke. The Amal carburetor of each engine has been fitted with an extended intake tube of venturi cross-section into which engine suction draws ash. Small conveyors, independently driven by chains and sprockets, feed ash from closed hoppers to intake tubes.

Coal ash used as standard throughout the tests came from tail flues of a pulverized-coal-fired Lancashire boiler. This ash contains about 20% carbon, and about 80% passes through a 240-mesh B S sieve. Rate of ash-injection adopted (52 grams per hr) corresponds to about the amount present if engines were run on diesel cycle at 100 lb BMEP, using coal with 2% ash.

Some 27 combinations of materials for liner, piston, and rings have now been tested in this manner. Liner materials include aluminum alloys, unhardened, hardened and tempered cast irons, nitrided cast iron and steel, anodized aluminum and chromium-plated cast iron. Most tests have been made with ordinary cast-iron pistons and rings, but have also been made with especially tough close-grained, cast-iron pistons and rings. Effect of anodizing, tinning, nitriding, and chromium-plating has also been checked.

Tests made so far all show certain common wear characteristics. Thus liner wear is almost entirely confined to ring track and reaches a maximum at a point slightly below the track top. Piston wear confines itself largely to thrust-faces, being greatest at top or first ring land and decreasing progressively toward the skirt. Ring wear is always most severe at top and least in bottom ring.

Results indicate that liner hardness is a vital factor in determining wear of liner, piston and rings. Thus lowest rates of wear of all three parts have been obtained with chromium-plated and nitrided liners and highest rates with aluminum and unhardened cast iron. The former show considerable advantage over ordinary cast iron. It has also been found that substitution of hardened rings for plain cast-iron rings, in conjunction with a hard liner, reduces rate of ring wear at expense of somewhat increased liner wear.

Best results to date come from a combination of certain types of chromium-plated liners and ordinary cast-iron piston and rings. With these combinations, rate of liner wear runs about 1/70, rate of top-ring wear about 1/16 and piston wear about 1/30 of that obtained with ordinary cast-iron liner, piston and rings. The table shows that in spite of this reduction, actual rates of wear are still high, but it is believed that abrasive conditions in these tests are more severe than those encountered in powdered-coal engines.

The table also shows influence on wear rate of fineness of ash. These results were obtained with ash prepared from two samples of the same coal, a Northumberland steam coal, ground to 58 to 92% through a 240 B S sieve, respectively. Ordinary cast-iron liner, piston and rings were used in each case. It can be seen that increasing fineness of powdered coal reduced wear of the three parts by about 25%. The finer sample probably compares fairly closely, as regards size, to the ash actually liberated in the cylinder of a powdered-coal engine. The finer ash gave rates of wear about one-half that with ash used in main tests.

Comparative tests have also been made to note difference in abrasive action of ash from the bright and dull fractions of a South Yorkshire medium-caking coal. Coal samples were ground to a fineness of 81% through a 240 B S sieve and were used with ordinary cast-iron liners, piston and rings. As shown in the table, wear rates with the dull fraction more than double those with the bright fractions.

TEST RESULTS

Influence of Liner Hardness on Wear of Liner, Piston and Rings

Liner	Hardness, VPH value	Maximum liner wear, 1/1,000 in. per hour	Top ring wear, grams per hour	Maximum piston wear, 1/1,000 in. per hour
Aluminum alloys	60–145	10.0 –11.45	2.46–4.96	0–8.4
Unhardened cast irons	200–240	2.1 – 3.5	1.83–2.60	3.25–6.3
Hardened cast irons	500	1.20	0.90	2.4
Nitrided steel and cast irons	950–1,000	0.46 – 0.61	0.16–0.61	0.31–1.41
Chromium-plated cast irons approx.	1,000	0.046– 0.112	0.15–0.70	0.20–1.55

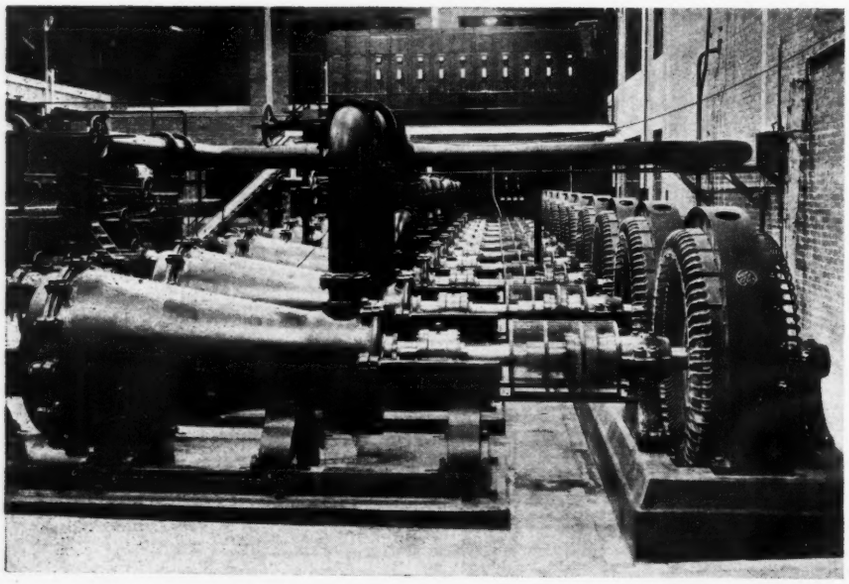
Influence of Fineness of Ash on Wear of Liner, Piston and Rings

58% through 240 B S sieve	2.02	1.26	1.57
92% through 240 B S sieve	1.54	0.93	1.17

Comparative Wear Figures with Bright and Dull Fractions of a South Yorkshire Medium-Caking Coal

Brights	0.74	0.514	0.67
Dulls	0.52	1.173	1.97

How to Get Your Money's Worth in Buying Synchronous Motors



Ten 350-hp, 0.8-pf, 400-rpm, 2330-volt synchronous motors driving paper-mill Jordans

Here are some pointers that will help you select the right motor for your job

By A G FERRISS
Industrial Department
General Electric Co

ENGINEERS WHO PLAN new-plant equipment are responsible for specifying motors and controls that will give reliable and trouble-free service. Synchronous motors and controls are usually tailor-made for each installation and involve a rather large investment. Therefore, the engineer requesting quotations from electrical manufacturers describes in detail the duties which must be met by the equipment, and often specifies types, characteristics and construction features.

When such purchasers' specifications are received, each electrical manufacturer will try to quote equipment exactly in accordance with the specifications. In addition, they will also offer alternative quotations when an analysis of essential requirements indicate possibilities of savings if the purchaser will waive certain non-essential special requirements.

The attitude with which these alternative proposals are received depends upon the type of project and personalities involved. If it is a municipal, state or federal project in which sealed bids are made, such alternatives may be disregarded or, if considered seriously, the bids may be cancelled and revised specifications issued. This causes embarrassment to the engineer responsible for planning the project and causes added expense and delay. On the other hand, engineers planning new equipment for an industrial plant may welcome alternative quotations. They are not bound to acceptance of the low bid and have greater freedom of action to select equipment best suited to the job.

Opportunities for Saving

Let us explain briefly opportunities for savings which are most frequently presented by electrical manufacturers as alternatives on lower-cost equipment. For example, suppose the plan involves a storm-water pumping station involving large low-speed synchronous motors, direct connected to centrifugal pumps. Should 40- or 50-C rise motors be specified? For this service, electrical manufacturers would suggest 50-C rise motors to save approximately 5% on motor cost. They would point out that the motor would be used only infrequently for storm-water pumping, load would be steady and would not overload the motor, service records of 50-C rise motors for this application give long dependable service. Therefore, the extra 5% investment in a 40-C motor is not profitable.

As another example, assume an industrial plant requires both induction and synchronous motors of many sizes and that reduced-voltage starting equipment for all motors over 200 hp is specified. If the equipment includes low-speed synchronous motors for driving reciprocating compressors, electrical manufacturers will offer an alternative quotation of full-voltage control for these motors, and motors suitable for full-voltage starting at a lower cost than those for reduced-voltage starting.

Low-speed synchronous motors for compressor drives have full-voltage starting currents which are usually less than 300% of rated full-load value. With this starting current they develop suitable starting torque for compressor drive. Therefore, there is no point in using reduced-voltage starting. A saving of approximately 50% on the control cost and 5 to 15% on the motor cost can be realized by using full-voltage equipment for low-speed compressor motors.

Obsolete methods of construction are sometimes specified. The electrical manufacturer will then naturally offer his standard construction on which he can make shipment more quickly. Saving in time is often a valuable consideration.

These examples indicate possibilities of making substantial savings by taking into consideration all the factors influencing cost of the equipment.

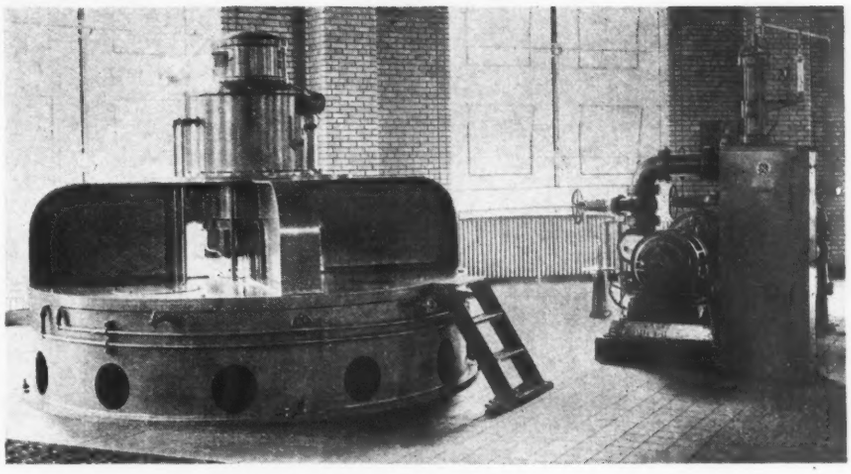
Major factors that influence selection of suitable equipment are: requirements of the driven machine; capacity and stability of power supply; cost of power; location and operating conditions. For example, assume an engineer selects synchronous motors and control for wood-pulp Jordan machines. Experience with this application shows that, where it is not desirable to withdraw the plug and clean out the Jordan before starting, or where pumping action may take place due to the peculiarities of the installation, synchronous motors should develop 100% pull-in torque. Other records show that where operators are careful, motors that develop 50% pull-in torque and 150% pull-out torque can do the job. Motors that develop 100% pull-in torque are naturally more expensive than those with 50% pull-in torque. Therefore, if the engineer is convinced that his installation requires the higher-torque motors for reliable operation, he should word his specifications so that all bidders will know that lower-torque motors are not acceptable. When he does this, it should be after he has satisfied himself that the more expensive motors are justified to meet the requirements of the particular application.

Power Supply

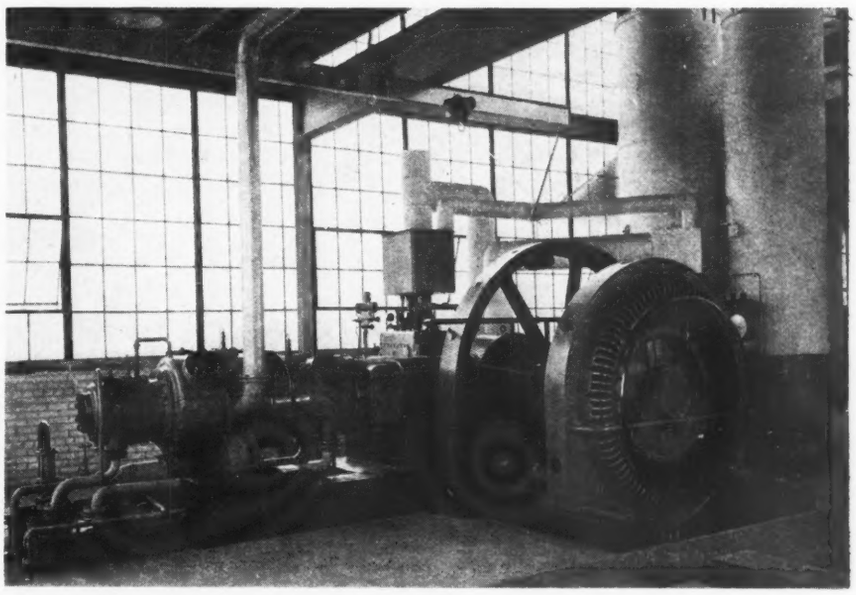
Capacity and stability of power supply are the next factors to consider. Starting and pull-in torques of synchronous motors vary as the square of applied voltage to the motor terminals. If the motor starts on full voltage, and the voltage drops 10%, motor starting torque will drop 19%. Since torque guarantees by electrical manufacturers are based on full voltage applied to the motor terminals, the engineer must specify sufficient torque to compensate for the anticipated voltage drop on his power system. Allowable voltage drop is influenced by several other factors, such as light flicker and speed drop by other motor drives. Capacity and stability of power supply also have an important bearing on the interrupting capacities of circuit breakers to provide adequate protection. Needless to say, circuit-breaker capacities should be definitely specified.

Power cost is another important factor. Synchronous motors are inherently high-efficiency machines. Usually, additional investment required to obtain higher than normal efficiency is not justified by savings in motor losses, unless power cost is unusually high and operation runs 24 hr per day.

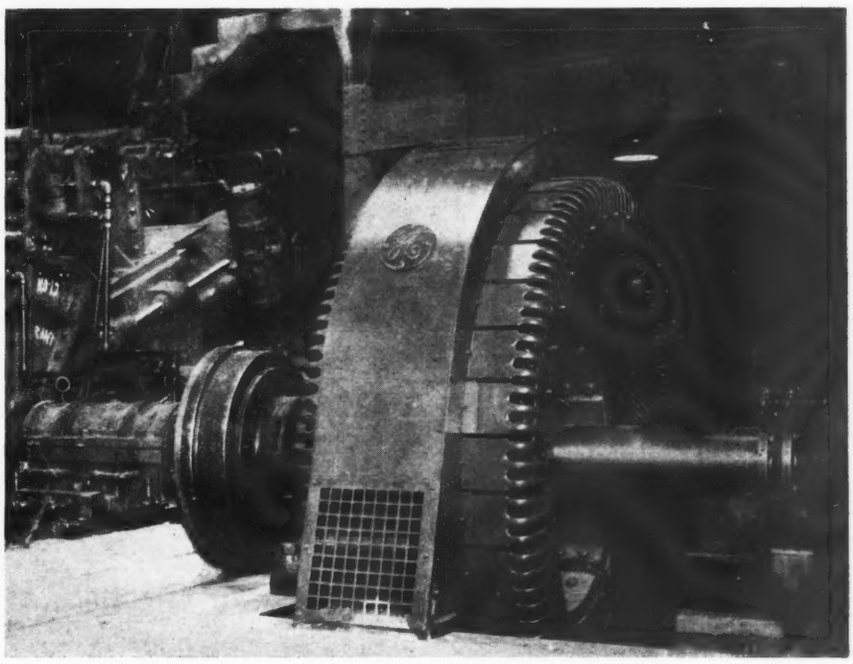
Location and operating equipment



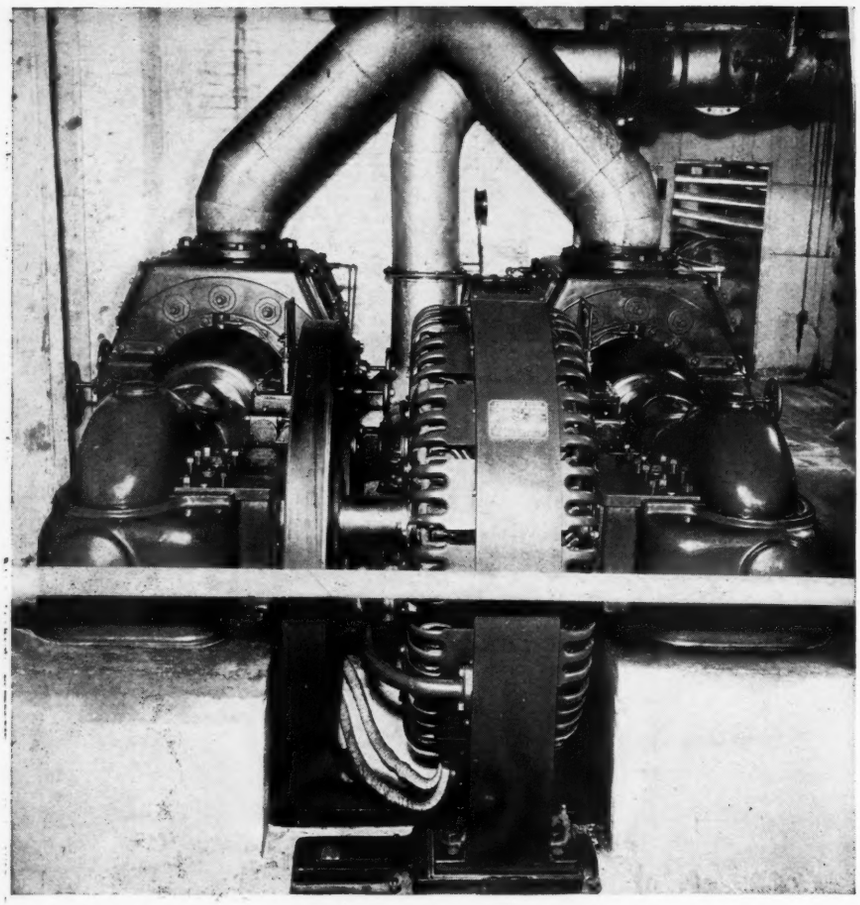
A 2300-hp, 1.0-pf, 200-rpm, 4600-volt, full-voltage-start vertical synchronous motor drives centrifugal pump. Motor-generator-set exciter and control at right



A 175-hp, 1.0-pf, 144-rpm, 4800-volt synchronous motor powers an oxygen compressor



A 1500-hp, 0.8-pf, 240-rpm, 6600-volt synchronous motor driving a pulp grinder



A 150-hp, 1.0-pf, 277-rpm, 220-volt synchronous motor with automatic control drives a reciprocating compressor in a yeast plant

have an important bearing on the type of synchronous motor and especially on the type of control. From the standpoint of minimum maintenance and trouble-free service, enclosed control and switchgear of both the cubicle and metal-clad types are often well worth the additional investment. Always carefully specify the type and degree of enclosure; that required by the synchronous motor is usually much less than that needed by the control. The motors are inherently heavy rugged machines which limits their need for enclosures to unusual specific conditions.

Synchronous motors require a source of direct-current power for excitation. This may be furnished either by direct-connected exciters, belted exciters or motor-generator exciter sets. Customary excitation is at 125 volts, although 250-volt excitation is common, especially for large installations. For individual units, direct-connected exciters are most economical for high-speed motors while belted exciters or motor-generator exciter sets are commonly used for low-speed motors. A single motor-generator may be used to supply excitation to a group of motors. In this case, an individual motor-field rheostat should be furnished with each motor. If it is not necessary to vary the excitation to each individual motor, specify fixed-tapped motor-field rheostats to save cost. When a motor has its own individual exciter or motor-generator exciter set, then the motor-field rheostat is not necessary, since motor excitation can be adjusted by the exciter-field rheostat.

Motor Specifications

The engineer may not consider his work completed until he has filled several pages with specifications detailing construction features of the equipment. He often feels that this is necessary, especially for sealed bids awarded to the lowest bidder. Naturally, he wants to specify first-class-equipment construction features, but he must so write his specifications that several manufacturers can quote. The easiest way to do this is to take each part of the equipment and ask himself what he wants each part to do. In this way, he can avoid circumscribing details which might tend to force some manufacturers to use methods of construction which they have discarded as obsolete.

For example, one manufacturer for a certain range of ratings may use welded fabricated stator frames, while another will use modern foundry equipment for cast frames in the same range of ratings. Either type of frame is adequate when co-ordinated with the manufacturer's methods of design and factory facilities.

The engineer will naturally want to include in his specifications such accessories, spare parts and testing requirements as he deems necessary. These items should be carefully scrutinized to eliminate unnecessary expense. This is especially true of tests. Admittedly, tests do not add anything to the intrinsic value of the material. Therefore, if a rather large sum must be spent to obtain test results, the use to which they will be put should be carefully considered to determine if they are worth the expense. Electrical manufacturers charge for extra testing and also for witness tests as compared to certified test reports.

Control Specifications

Specifications for control equipment must necessarily depend largely upon capacity and stability of the power supply, short-circuit protection required and type of control to be used. It is important that the required control equipment should be specifically itemized so that there will be no question but what all bids will include complete equipment.

In writing specifications for synchronous-motor and control equipment, the general procedure is, therefore, to state fully the requirements of the installation including capacities and characteristics of the driven machine. Also to provide adequate information on capacity and stability of the power supply, and to describe the operating conditions and any special requirements due to location. Secondly, all necessary electrical equipment, including motors, exciters and control, should be carefully itemized with their accessories, to be sure that all bids will include complete equipment. The border line between the manufacturer's equipment and the purchaser's equipment should be carefully drawn. Finally, detailed specifications on construction should avoid special features and permit the manufacturer to use modern methods to obtain high-quality products.

In the end, the purchaser's engineer must himself decide what particular equipment is best suited to his needs and his specifications should leave no one in doubt as to what is required in the equipment.

Gas-Flow Control for Dust Collectors

More and more plants, industrial as well as utility, find it necessary to install dust collectors. This has focussed attention on control equipment, which has to be put in right. Here are three examples of how dust-collector operation ties in with combustion control

By CHESTER R EARLE
Republic Flow Meters Co

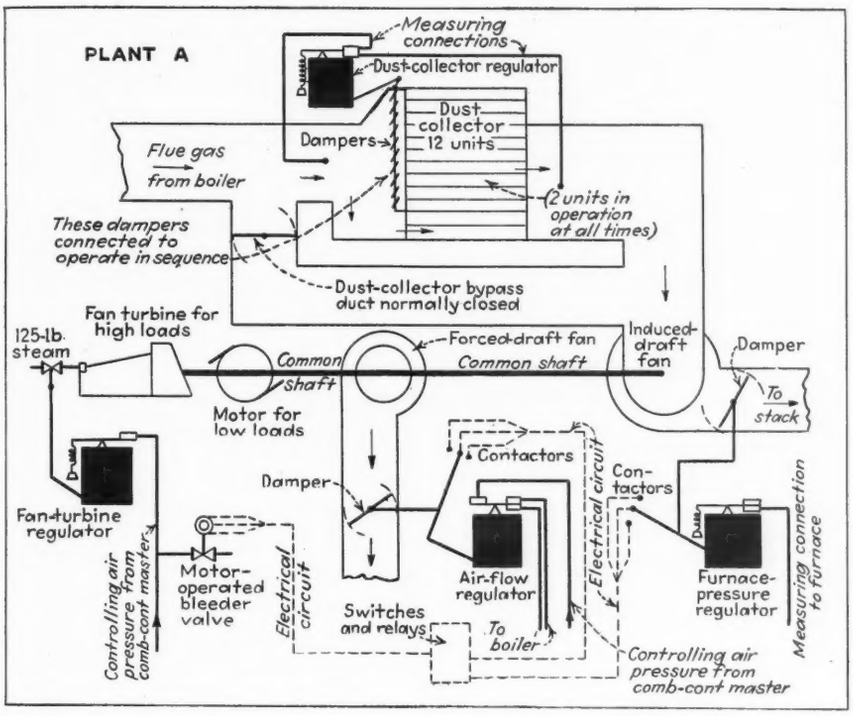


Fig. 1—Control of dampers to hold constant pressure drop across dust collectors requires readjustment of fan-turbine speed to keep dampers in good regulating range

RECENT POWER-PLANT developments include increasing use of dust collectors to remove flyash from boiler flue gas before it is discharged to atmosphere by the stack in industrial plants as well as central stations. In many instances this cleaning process is required by considerations of sanitation and public relations, and sometimes even by municipal ordinance.

Two generally used types of dust collector are electrical and mechanical. Although the dust collectors referred to are all of the mechanical type, methods used for automatic control can often be applied to the electrical type.

Automatic control of dust-collector operation presents a problem for the designer of boiler-control equipment because in many cases the control system must govern flow of flue gas through the collectors. This flue gas in turn comes from or passes to another apparatus that is also automatically controlled. As a result, the control of dust collectors, which in itself may be a simple problem, introduces factors that may require modifications to or amplifications in the automatic regulation of draft equipment. Accordingly, all factors in the system must be coordinated.

General requirements for coordinating dust-collector control with other factors in the automatic boiler-control system are well illustrated in three recent installations. These cases illustrate various combinations of standard control elements such as regulators, power cylinders, damper actuators and occasionally electrical contactors, relays and standard switching equipment.

Multiple-Cyclone Units

The three plants include two large industrial power plants, referred to here as Plants *A* and *B*, and a medium-size central station, Plant *C*. In all three plants the dust collectors are mechanical.

In Plant *A*, the dust-collector system consists of 12 multiple-cyclone units, installed between boiler and induced-draft fans, as shown in Fig. 1, and provided with a bypass duct that is normally kept closed. The boiler is under complete combustion control. Two of the collector units are kept wide open at all times to prevent accidental complete closure of the gas passage. The remaining 10 units are controlled by dampers operated in sequence through a shaft and cam system to cut collector units into or out of service as the amount of flue gas varies with boiler load. The dampers are connected and operated in such a way that required collector capacity is obtained over the load range and constant gas velocity is maintained through the collector units by holding constant pressure differential across them.

This part of the control problem is simple. A full-floating regulator measures the dust-collector differential, balances it on a beam against a spring and automatically operates the collector dampers in sequence to hold the differential constant.

The real problem here is created by the fact that the forced- and induced-draft fans are mounted on a common shaft, driven on one end by a constant-speed motor with a free-wheeling clutch and on the other by a geared steam turbine. The motor drives the two fans when load is low. The turbine, with a wide range of speed control, drives the two fans at heavy boiler loads, the position of the turbine steam-control valve being varied with boiler load by a regulator controlled by an air pressure from the combustion-control system. This regulator is equipped with a corrective device, as explained below, to keep the

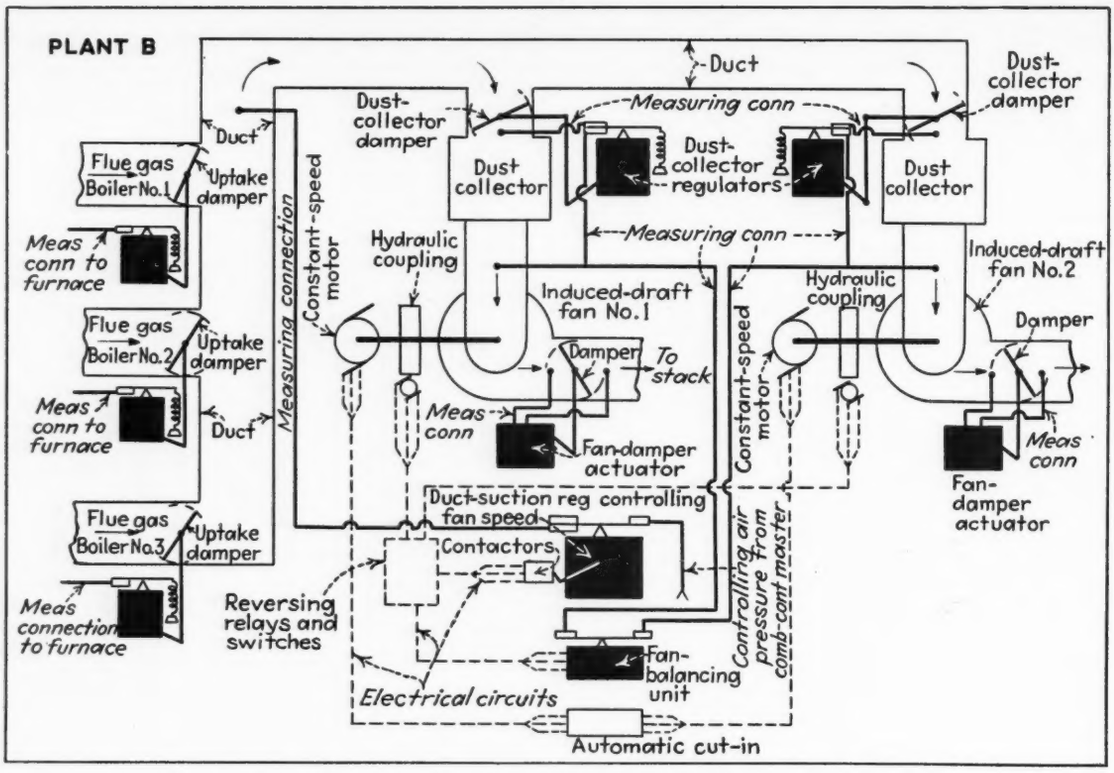


Fig. 2—Dust-collector regulation coordinated with automatic control of induced-draft-fan hydraulic couplings. Speed-matching devices keep two fans in step

forced- and induced-draft fan dampers within good operating range. The damper in the forced-draft discharge duct is operated by a regulator of the combustion-control system to change the air flow through the boiler in relation to load, while a damper in the induced-draft-fan discharge duct is controlled to maintain constant furnace pressure by another regulator responsive only to that pressure.

Now, when the boiler load changes, the combustion-control system adjusts the fuel feed and, in synchronism, controls the forced- and induced-draft fan-damper regulators and the regulator controlling the speed of the turbine driving both fans. These adjustments change the flow of air and flue gas through the boiler and, as a result, the dust-collector regulator will operate to maintain constant pressure drop through the dust collectors by cutting units in or out of service. This operation may in turn affect the flow through the fan discharge dampers and cause them to approach too close to open or closed position, thus preventing good regulation. Accordingly, a readjustment of the fan speed with relation to the fan dampers is necessary.

Therefore, to keep the fan dampers within a range of 20 and 80% open, their regulators are equipped with contactors connected in the circuit of a small motor-driven bleeder valve in the air-pressure control line leading to the fan-turbine valve regulator. When the dampers approach the range limits, the contactors open or close the bleeder valve, thus changing the air pressure controlling the fan regulator and adjusting the fan speed the required amount to keep the dampers within the set range. The wiring is connected so that both forced- and induced-draft fan dampers must require a decrease of fan speed before it can be obtained. Either damper, however, can produce an increase in fan speed.

Damper and Fan Controls

In Plant *B*, Fig. 2, a situation arises that is similar in fundamentals to that of Plant *A*. Here, too, approximately constant gas velocity must be maintained through two dust-collector units. In this case, two induced-draft fans serve three boilers, and one collector unit is installed just ahead of each fan. These fans are driven by constant-speed motors through hydraulic couplings. Control of quantity of oil in the latter gives speed control of the fans.

The setting of each boiler-uptake damper is controlled, to hold furnace pressure constant, by a full-floating, measuring-type regulator of the combustion-control system. The induced-draft fans are operated to maintain the suction in the common flue-gas duct at such a value that the boiler-uptake dampers are always in good regulating range. This is done by a single fan-speed regulator in the combustion-control system which operates contactors controlling the motor-driven reversible oil pumps of the two hydraulic couplings, thus varying the fan speed. Also, if the speed of one fan lags behind that of the other, a fan-balancing unit increases the speed of the slower fan to equal that of the other.

When the combustion-control system, responding to a change in boiler load, changes the speed of the fans, the flow of flue gas through the boilers and the common duct ahead of dust collectors and fans also changes. Therefore, the damper of each dust collector is operated by a full-floating measuring regulator to maintain constant pressure drop across the collector, thus holding constant gas velocity through it. Fig. 2 shows how the various elements in this system are coordinated for good regulation.

Turning now to Plant *C*, Fig. 3, we find a somewhat different situation. Here the control of the dust collectors is more complex but has no influence on the automatic-combustion-control system proper, because the dust collectors are installed following the induced-draft fan.

One high-pressure pulverized-coal-fired boiler is installed under complete combustion control. The induced-draft fan, operating at constant speed, draws the flue gas from this boiler through an air preheater and discharges it to dust

collectors as shown, from which it flows to the stack. Flow of air and flue gas through the boiler is controlled by the air-flow regulator of the combustion-control system which operates the induced-draft-fan discharge damper in accordance with a controlling air pressure from the combustion-control system.

The dust collector is divided into three sections, connected in parallel. Each section contains a number of small cyclones. Ahead of each section is a louvre damper operated through linkage and bell crank.

First, one collector section is left open at all times to prevent accidental closure of the gas passage to the stack. As the load increases, it is then desired to open progressively the second and then the third collector sections to provide the required capacity. To do this, the dampers of the respective collector units are always either wide open or completely closed. They do not regulate the flow of gas nor maintain any specified pressure across the collector, but merely open or close the inlets of the sections according to the load, which determines the amount of gas discharged to them by the induced-draft fan.

Accordingly, the control system shown in Fig. 3 was designed. It consists of three oil-operated damper actuators, one for operating the inlet louvre damper of each collector section; these three actuators are operated by a single control device. This device receives the differential pressure across the air preheater and converts it into a control air pressure that varies with boiler load. This control air pressure is applied to all three damper actuators, which can be set by adjusting springs in such a way that they will open in succession at predetermined values of the preheater differential, which measures the flue-gas flow. The combustion-control system was not used to control these actuators because of certain characteristics of the boiler and automatic control with only one pulverizing mill in operation.

Damper Control

Each damper actuator, by means of a pilot valve, operates an oil power piston in an oil cylinder. When the control pressure on one of the actuators is below the value for which the actuator is set to operate, the pilot valve holds the power piston in such a position that its respective louvre damper is closed. When the control pressure on the actuator exceeds the control value for which the actuator is set, the pilot valve operates the power piston and opens the louvre damper.

Each actuator is equipped with a delayed-action device to make the opening pressure appreciably higher than the closing pressure, thus eliminating a critical on-and-off point that might cause hunting of the control. Each actuator is also provided with a manual adjustment by which its pilot valve can be operated to hold the louvre damper in the wide open position.

The center group of dust collectors is in operation at all times, its damper held open by setting the manual adjustment on the actuator, as described above. The control device and actuators are adjusted to open the other two section dampers in succession when the differential across the preheater increases to any predetermined value above 3 in. of water. That is, the second collector section damper will open when the differential reaches 3 in. or any predetermined higher value and the third section will open when the differential reaches a definite amount higher than that for which the second section is set.

As load decreases, the actuators close their respective dampers in succession by the operation of the pilot valves and power pistons in the reverse direction.

The three installations described above do not establish any broad fundamental principles of dust-collector control other than the fact that ingenuity in the employment of standard control devices is required to solve problems of this kind. They do, however, offer a good example of the fact that the designer of control equipment must consider the design and operating characteristics of the apparatus to which the control system is being applied. Only by so doing can he effect synchronized and centralized operations that feature modern boiler-control systems.

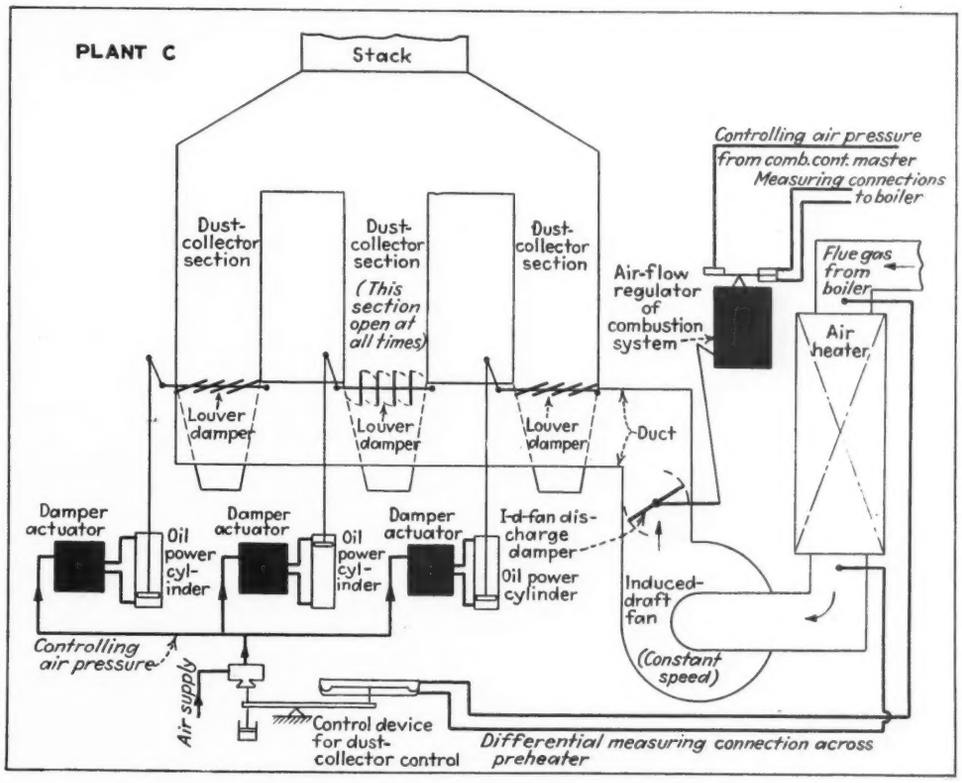


Fig. 3—Center section of dust collector is always in operation. Other two sections open in sequence when preheater differential rises

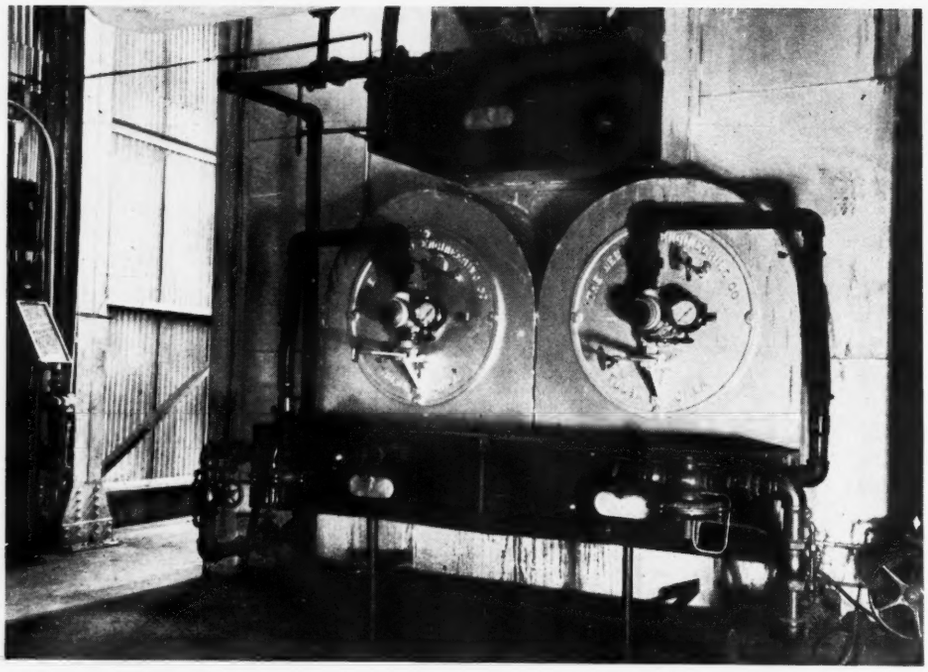


Fig. 1—Three gas burners fire new straight-tube boiler

More Steam for Masonite's "Guns"

New 1200-lb gas-fired boiler with combustion control adds 60,000 lb per hr to Masonite Corporation's unique boiler plant at Laurel, Miss.

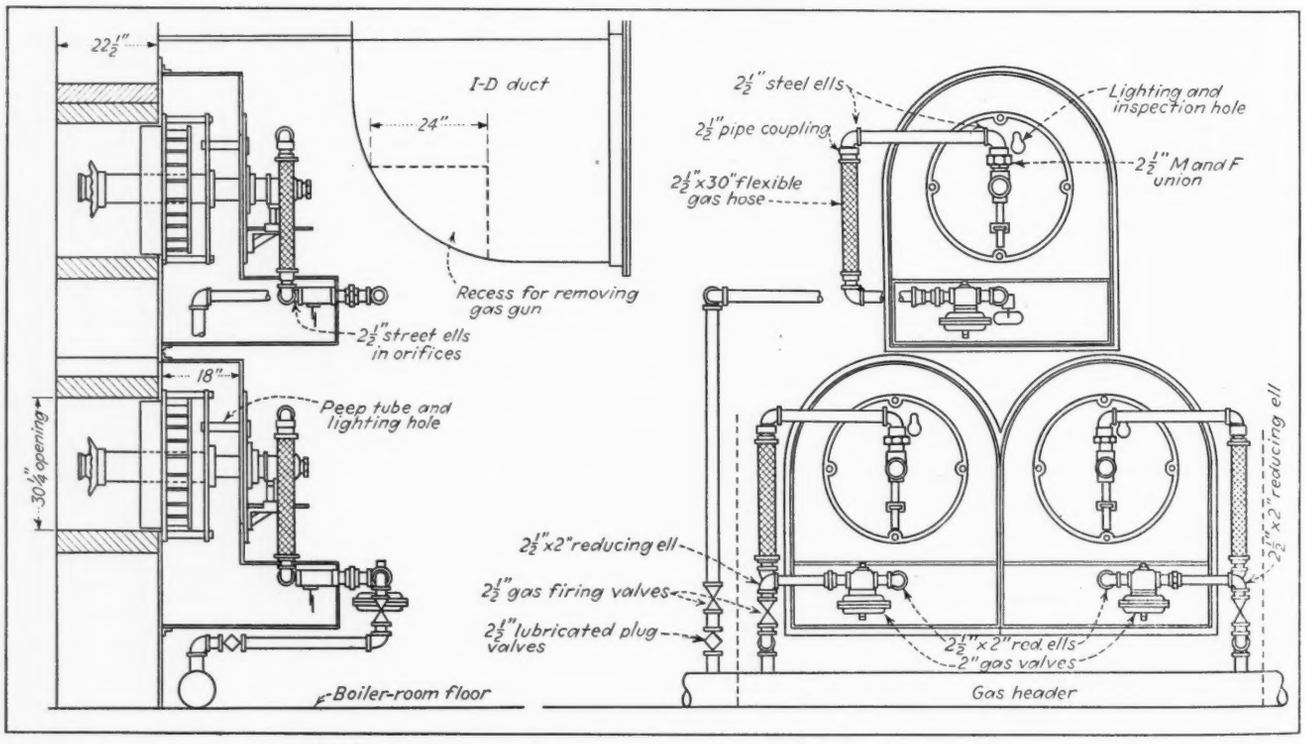


Fig. 2—Arrangement of burners, combustion control, and gas piping

UNIQUE PROCESS, unique boiler plant —that's the story at Masonite Corporation, Laurel, Miss. High pressure is old stuff at this plant—for the past 13 years they've been generating steam at 1200 lb but at saturation temperature, rather than up in the 900-F range. During this period plant has been extended and modernized several times. Latest addition is a new 1200-lb gas-fired boiler with controls to insure efficient combustion under all loads.

The manufacturing process of Masonite products is distinctly different from that of any other similar material. In this process, advantage is taken of the natural binding materials of wood, these and the ligneous fibers being coalesced by means of high temperature and high pressure to form a product which has great strength even when in the wet condition. These binding materials are retained by using saturated steam at 1200-lb pressure to explode wood chips in "guns", which produces a wood fiber not changed by any chemicals.

To serve the gun load, a 1200-lb boiler was installed in 1926, along with two 200-lb refuse-burning units. Growth of production required adding another high-pressure unit and two low-pressure boilers in 1929. All these Babcock & Wilcox units are equipped for gas firing. Low rates and nature of power and process loads dictated purchased power.

Boiler

The recently installed boiler, a Combustion Engineering straight-tube unit, adds 60,000 lb per hr steaming capacity, at 1200 lb. Boiler heating surface is 5300 sq ft and economizer accounts for 2400 sq ft more. Three Webster Engineering Co gas burners fire into a 3100-cu ft refractory furnace capable of handling 24,000 Btu per cu ft per hr heat release. A single motor-driven induced-draft fan, of 34,000 cfm capacity, meets draft requirements.

Older boilers are not equipped for automatic combustion control; arrangement on new boiler is interesting in design and has proved successful in operation. The photo and piping diagram (Figs. 1 and 2) show layout of burners and the Webster Engineering Co control system. As applied to this boiler, control equipment maintains a constant air-fuel ratio while manual damper adjustment meets load changes.

A proportioning device, Fig. 3, forms the heart of the control system. As installed at Masonite, this device is mounted in the short duct leading to burner registers. This duct forms an orifice for air flow; drawing of proportioning device shows corresponding orifice in gas line. In each orifice, flow acts on vanes connected to a common shaft. Orifice size and vane area are so balanced that when air and gas flows maintain proper relation for best CO_2, vanes stand in neutral position. Changes in either gas flow or air flow produce an unbalanced force which moves the vanes and turns the common shaft.

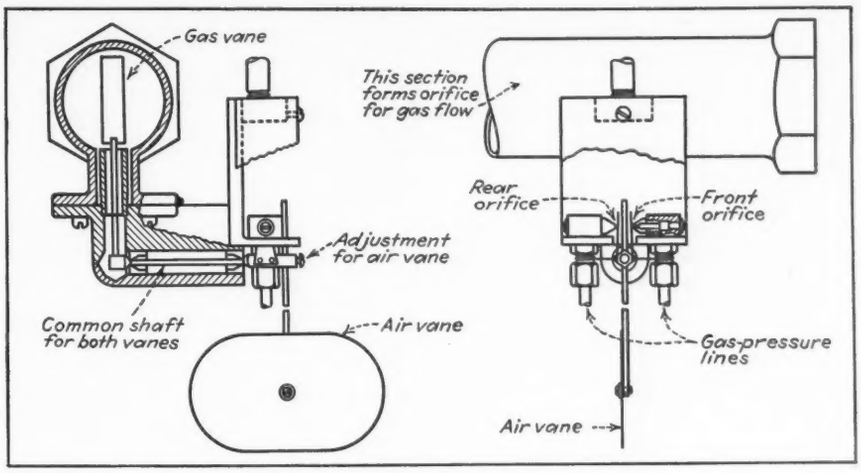


Fig. 3—Section through gas-air proportioning device

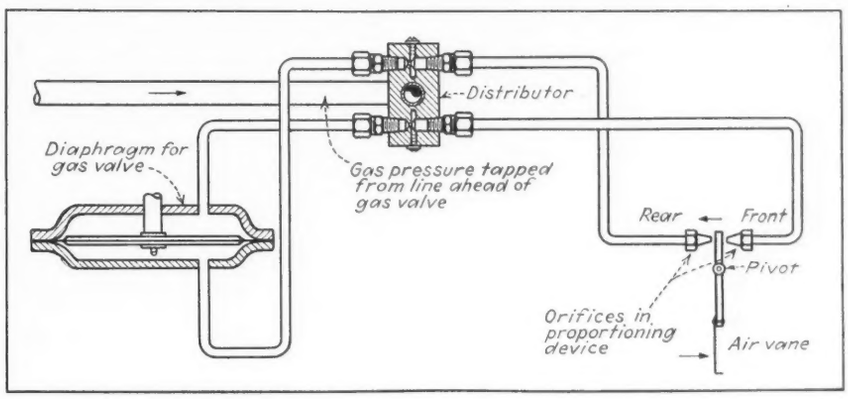


Fig. 4—Connections between proportioning device and gas-operated diaphragm valve

A gas-operated diaphragm valve converts motion of vane into control action as shown in the schematic, Fig. 4. Assume increase in air flow, due to opening damper or other cause. Change in flow increases velocity pressure on air vane, overbalancing resistance of gas vane and causing the entire assembly to move on the pivot. This motion closes off rear orifice. Gas pressure, tapped from line ahead of gas valve, builds up behind closed orifice and back to under side of diaphragm, while continuing to bleed off through front orifice. Unbalance in pressure on diaphragm causes it to rise, opening gas valve wider. Increased gas flow exerts added pressure on gas vane and restores vane assembly to neutral position. Gas pressure bleeds off through both orifices in proportioning device, pressure equalizes on both sides of diaphragm and valve setting stays the same until the next change in air or gas flow.

An exactly similar cycle takes place when gas flow decreases for any reason, and a reverse cycle follows an increase in gas flow or a decrease in air flow. Raising or lowering air vane, which is adjustable, regulates CO_2 maintained. Dropping the vane means that less air velocity will be needed to balance gas velocity; thus, lowering the vane cuts excess air and raises CO_2.

Simplicity marks gas connections to this boiler. Lubricated plug cocks serve as shutoffs throughout. Gas line from meter house outside boiler room ties directly to header with a plug-cock and hand-valve in boiler room. Connections to each burner include a plug-cock and firing-valve ahead of the gas-valve. A section of flexible gas hose in line from gas orifice to burner permits adjustment of register-type gas guns with respect to inside of furnace wall.

No special safety devices are provided but careful operation keeps the record free of gas explosions. Lubricated plug-cocks provide tight shutoff, preventing gas leakage into standing boiler. Operators carefully vent furnace for at least five minutes before lighting off—sound practice with gas.

Editor Takes Greeley's Advice

Phil Swain goes West to meet western engineers, study their plants and doings, and see the country they serve—here are pages from his diary: Denver, Colorado Springs, Salt Lake, Boulder Dam

THIS IS A POWER engineer's diary —a rambling account of what I see on an editorial tour from New York to the Pacific, up the Coast to Vancouver and back east through Canada. It will take seven weeks, same as the European trip I took in 1936. That covered 2500 land miles and six countries. This time I cover three times as much ground in America alone. Ours is a big country.

To Denver by Zephyr

In Chicago, one night out from New York, I board one of the Zephyrs for the overnight run to Denver. First two of twelve gleaming stainless-steel articulated cars enclose 3000 hp in 3 diesel-electric sets. A third car carries mail at one end; at the other are auxiliary diesel generators to light the train and power its air conditioning.

On the trip to Denver we average 66 mph, including stops, and reach a top speed of 102 mph during the night. Yet riding is smooth. Train has a low center of gravity, precision wheels, roller bearings, and complete air conditioning with windows hermetically sealed.

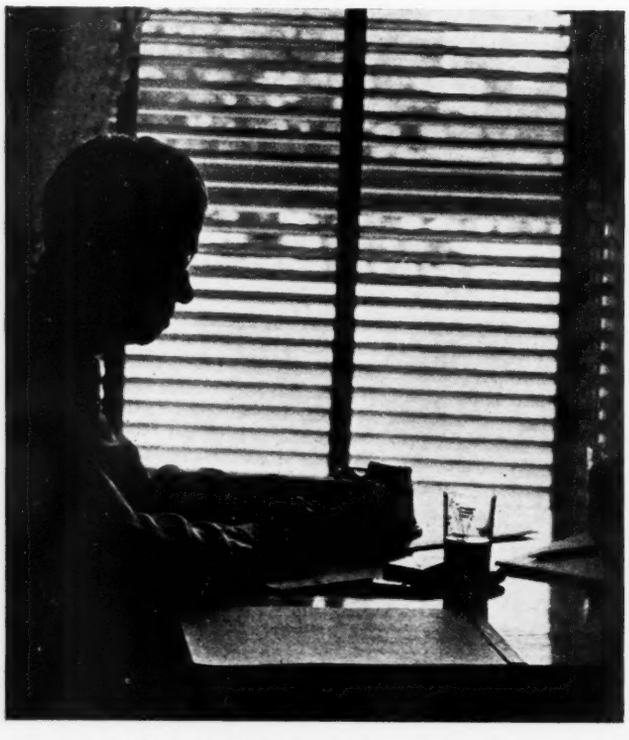
In mile-high Denver, POWER's old friend, J J Monaghan, greets me at the station and takes me out to his apartment to meet the wife and talk shop. Until recently, Jack ran the plant at Broadmoor Hotel, Colorado Springs, but now is chief at Children's Hospital in Denver. We start by discussing his article on the Broadmoor plant and wind up talking about his early experiences working for American Brass, Allis-Chalmers, Bethlehem Steel and Texas Co. Soon the conversation swings around to Solomon's Temple. Student of archeology, Jack says nothing less than 5000 years old is really interesting. Every man to his taste!

In the afternoon I take the short run down to Colorado Springs on the Denver, Rio Grande, and Western. Just west of the tracks rises the great wall of the Rocky Mountains. East are the plains. To me this great north-south line between the endless plains and the endless mountains is the place where the West begins.

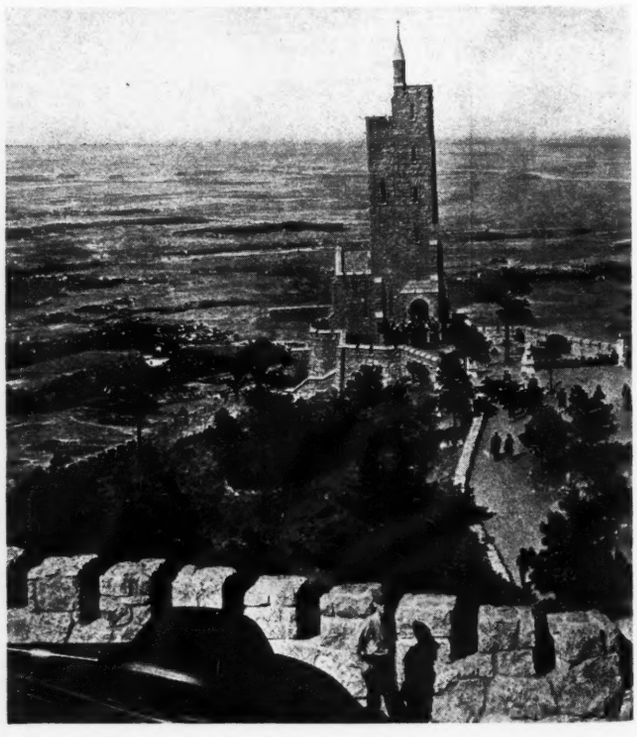
Colorado Springs is a garden spot and its heart is the magnificent Broadmoor Hotel, a sort of private empire. Manager Ogilvie puts me up in a room fit for a king—from my window I can see the Will Rogers Stadium across the lake, and the Will Rogers Shrine high up on Cheyenne Mountain.

Broadmoor Power Plant

In Broadmoor's power plant Harry McMillin, present Chief, lends a hand while I photograph his new boiler, new 500-kw bleeder-condensing turbine and two older 200-kw backpressure turbines. With these he heats and powers all Broadmoor properties within reach.



Denver sunlight silhouettes Jack Monaghan as he checks an article on the Broadmoor plant for a coming issue of Power



Will Rogers Memorial Shrine on Cheyenne Mountain. Harry McMillin, Chief Engineer, Broadmoor Hotel, in foreground

You'll find the engineering story in a coming issue of POWER.

The day's work over, Harry drives me up Cheyenne Mountain. From the top we see Pikes Peak and look down on Colorado Springs and the plains that run east for 1000 miles. Going down the mountain, we pause to visit the big private zoo and the great granite tower of the Will Rogers Memorial Shrine.

Through the Rockies

This day carries me through the unending beauty of the Rocky Mountains. Our D R G & W train runs south a few miles to Pueblo, brown and arid industrial town, then west for the long climb through the Rockies along the winding Arkansas River. Not far beyond Pueblo we pass Canyon City and the train stops for sightseeing in the Royal Gorge. Spanning the Canyon and 1053 feet above us, hangs a suspension bridge 1250 ft long. You can barely see the cars on it.

Late in the afternoon we pass two of the highest peaks in the Rockies, Mt Massive (14,418 ft) and Mt Ebert (14,431 ft). Then the valley broadens into a wide green meadow, the Arkansas dwindles to a damp spot in the grass, and we slide over Tennessee Pass, which divides the waters of the Atlantic from those of the Pacific—elevation 10,240 ft. The air is thin but you like it.

Coming up the mountains the train burned plenty of Colorado coal. From now on, for many hours as it rolls down the Rockies through the valley of the Colorado, it runs on smoking brakes. We pass Leadville and other famous mining towns and camps. The train winds through gorge after gorge. The Colorado runs bigger and faster.

At dusk we strike Glenwood Canyon, where this young hellion of a river held its last rehearsal before carving out the Grand Canyon. From Glenwood Springs to Salt Lake there must be a lot of scenery, but night falls and I sleep through most of it. In blackness we roll down through the rest of Colorado and halfway across Utah.

Engineers' Heaven

Landing in Salt Lake City in the morning, I take a glance at the famous Temple of the Latter Day Saints, stop at the hotel to pick up mail from home, and then look up Willard Church, who tours around in his car selling POWER subscriptions over hundreds of miles of mountain country.

Lucky strike! Willard drives me 100 miles this afternoon and I see plenty. Straight south 35 miles along the mountain wall to the glistening little town of Provo, Utah. Here I find the long-sought "engineer's heaven"; everything perfect to my visitor's eye—the weather, the scenery, the power plant, its machinery, its operators, its maintenance. I refer to the Provo steam-electric plant of Utah Power & Light. It's a single-unit job, with outdoor boiler, built in 1936. You'll find some technical data with pictures, in the next number of POWER.

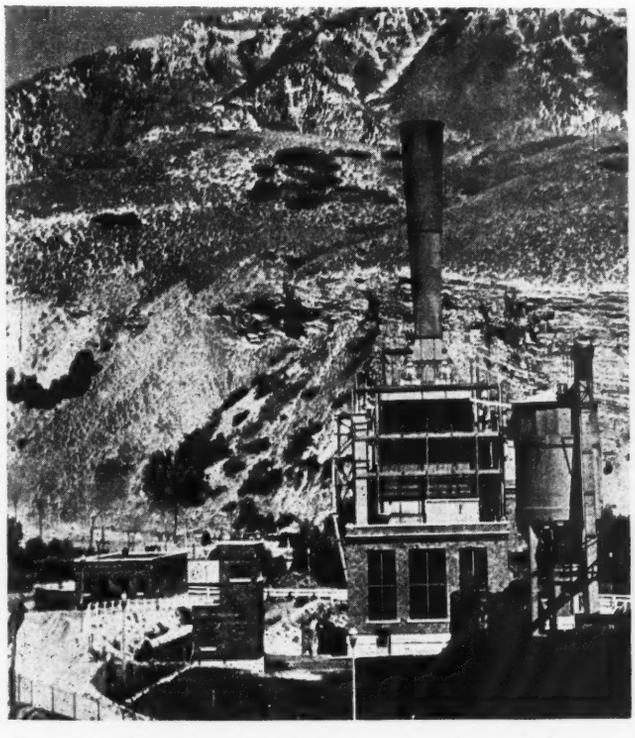
Here I meet Supt F B Williams and Asst Supt P A Blanchard. Mr Williams shows me around his power house—sunshiny, clean and neat beyond belief. He takes me over to the old Olmstead hydro plant, half a mile away, shows me its museum of pioneer electrical equipment. Then he takes me back to see the steam plant's gardens—flower, rock and rose.

Late in the afternoon, friend Church drives me up Provo Canyon and 60 miles back on the east side of the mountains to Salt Lake City, past wide pastures with grazing sheep and the little village of Heber with its quaint old stone-walled hydro plant.

On to Boulder Dam

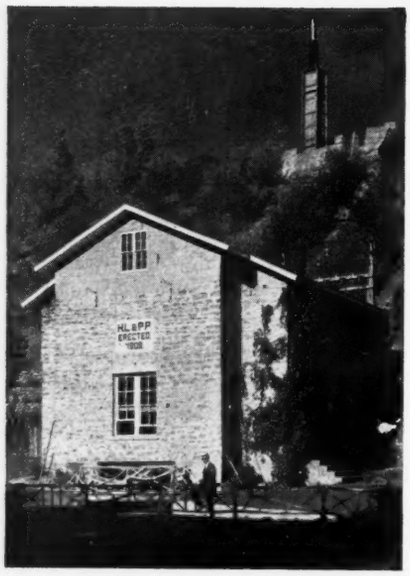
I awake in a train running through desert country—utter desolation. No trees, no grass, no houses, no people. Just a vast deadly overheated waste with clumps of sagebrush and an occasional cactus. Around us rise brown hills, parched, and eroded. In the train, air conditioning keeps me clean and cool until I step off into 105 Fahrenheit at Las Vegas.

By some miracle there is a little underground water at Las Vegas, so the town is a middling oasis in the endless desert. Main Street, a few blocks of dazzling sun, is packed solid with eating places, hotels and gambling houses. At the end of the street our air-conditioned bus for Boulder Dam plunges



Forty miles from Salt Lake City, great mountains back the semi-outdoor Provo steam-electric plant

F B Williams, genial Supt of Provo plant, stands in the flower garden outside the power house



Up in the mountains back of Salt Lake, this old hydro plant serves the settlement of Heber, Utah. Willard Church, Power circulation man, leans on the fence

Giant turbine-generators nearly fill the Nevada wing of Boulder Dam plant

suddenly into the waste land to ride 20 miles to Boulder City, man-made garden spot in the desert.

At a cost of $2,000,000, the U S Bureau of Reclamation hauled in top soil, brought grass seed from Australia, shrubs from somewhere else, and supplied the one all-important element—water. They built stores, schools, houses, churches, a hotel, and a government building. Like Las Vegas, Boulder is hot and dazzling but rather pretty in its way and very neat. When the dam was building, population ran 6–8000, but now it's down to 2500 and may drop to 1000.

It's another ten-mile run from Boulder City down to the dam. We stop on the way for a high-point view over Lake Mead, world's largest artificial body of water. Zigzags back 115 miles, almost to the Grand Canyon, but we can see only part of it—a great expanse of glistening water surrounded by bare brown crags. This lake will some day be one of America's great scenic playgrounds.

The Colorado is generous with its waters for irrigation and city supply—terrible with floods and droughts. Hence Boulder Dam—a mechanical Magna Charta. Men threw a concrete wall across Black Canyon from Nevada to Arizona, and backed up two year's normal river flow. Thus the Colorado is harnessed—for flow mainly, power incidentally.

World's Greatest Flywheel

From an engineer's angle you can think of Boulder Dam as the world's greatest flywheel, built to smooth out the eccentricities of the Colorado, to control floods, to make irrigation farming a business instead of a gamble, to insure city water supplies for Los Angeles and 13 surrounding communities, and to develop power to pump that water.

Power generated at Boulder Dam picks up Colorado water again at Parker dam, 150 miles downstream, and pumps it, when needed, over 250 miles of mountain and plain to the West Coast communities banded together in the Metropolitan Water District. Parker Dam, the Aqueduct, and the power transmission lines, cost $220,000,000 and the job is just about finished.

Boulder Dam power plant started operation in 1936, two years ahead of schedule. The dam is 726 ft high and 650 ft thick at the base. Water from four intake towers in Lake Mead runs through the turbines in the Nevada and Arizona wings of the plant. A bypass takes care of the excess if irrigation or flood control requires more flow than turbines discharge. Of the ultimate capacity of 1,835,000 hp, 752,000 hp is now in operation and two additional 115,000-hp units are being installed with two more on order.

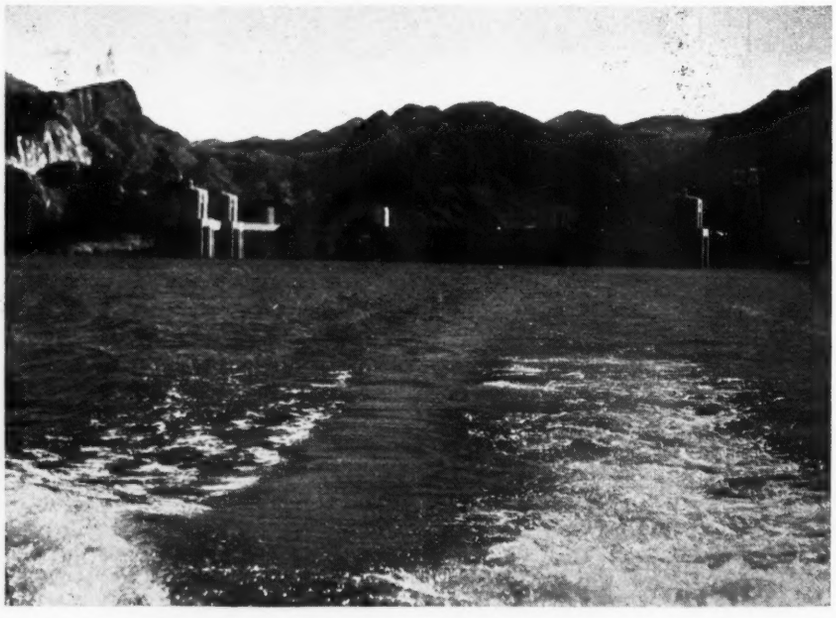
On Lake Mead

Our bus load of sightseers takes the elevator down through the middle of the dam's concrete. We stroll through the Nevada wing, nearly full of big turbine-generators and then out on the open platform alongside the big transformers and switches. Then comes the boat ride on Lake Mead to the face of the dam.

Lake Mead can hold 30,500,000 acre ft, but only part of this is dependable power storage. About 9.5 millions must be reserved for flood storage, and 5 to 8 millions to hold the silt that used to plaster the downstream country. This leaves 12 to 16 million acre ft of dependable power storage, and insures 665,000 kw of firm power.

We drive back to Las Vegas for dinner at the Apache Hotel. I take a last look at the neon-lighted gambling halls of this strange desert city and catch my train for Los Angeles. Later that night a hail storm hits Las Vegas, breaks windows and batters car tops to the tune of $200,000 damage. What a town!

More pages from Phil Swain's diary will tell of things seen and people met in the West Coast centers around Los Angeles and San Francisco.—Ed.



Face of dam and intake towers as seen from stern of boat on Lake Mead, largest artificial body of water in the world

Steam Makers View the Future

Handy to New York World's Fair, National District Heating Assn meeting combines a forward look at the industry with a glimpse of the World of Tomorrow

Glen D Winans brings presidency of NDHA to Detroit Edison Co

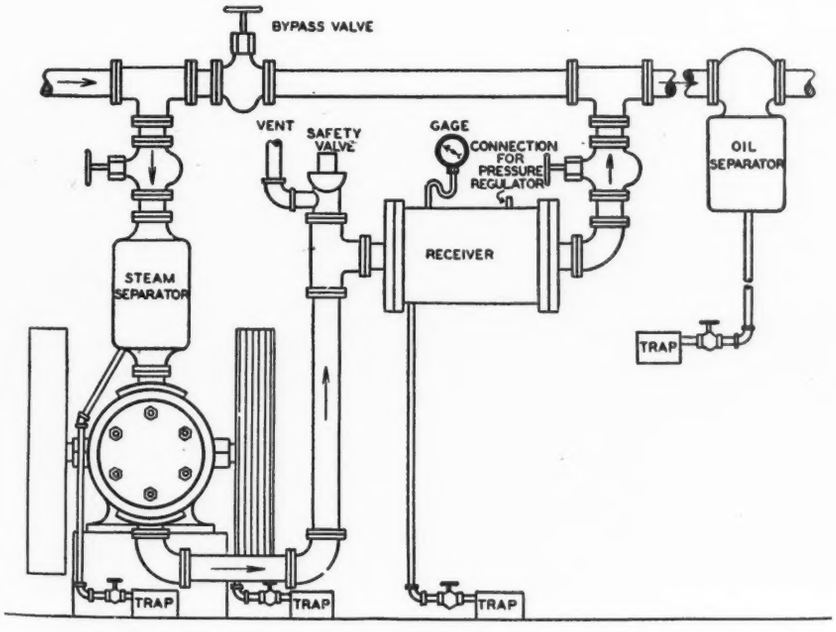
NEW YORK, JUNE 30—Opening the Thirtieth Annual Convention of the National District Heating Association after a morning session of committee reports, Glen Winans introduced a number of noted speakers including Floyd L Carlisle, Chairman of the Board, Consolidated Edison Co, New York; H B Bryans, Executive Vice President, Philadelphia Electric Co; Alex Dow, President, Detroit Edison Co; and Miss Clara Zillessen, Advertising Manager, Philadelphia Electric Co.

At the following technical session, J C Butler presented a progress report on a study of steam use in 133 typical buildings. Preliminary results indicate, said Mr. Butler, that control equipment pays for itself in from two to four years. Further study will be given the matter and a complete report published later.

By treating separately complaints arising from faulty operation of 15 types of heating system, R M Nee classified customer troubles. The intention, he explained, is to integrate the data to form a manual for service men. An instruction book for users of district steam is already available by writing the Association headquarters at 1317 Spruce St., Philadelphia.

Power-driven compressors to supply small quantities of steam at about 75-lb pressure from low-pressure supply mains were described by G H Tuttle. There are twelve known installations now operating, he said, and these have already demonstrated their economic justification.

An analysis of process-steam uses helps sell likely prospects, according to N H Davidson. Data on requirements as to operating pressure, demand, and consumption, even though generalized, enable meeting all steam needs, often a deciding factor in securing the customer.



Typical piping for compressing small amounts of steam from 1-p supply

Ten-year data on steam requirements of commercial and industrial buildings in St Louis show an overall reduction of 19% in steam required for building-heating, accomplished by improved equipment, closer control and better co-operation between customer and utility, reported R M McQuitty. Data also provides a basis for estimating steam use by various classes of customers.

Use of cooling degree-days for analysis of summer steam requirements enables explanation of variation in cooling load in a logical manner, according to H W Dierman. A study of three New York buildings for which complete data was available resulted in a plot of cooling ton-days as a straight line against degree days, on a 52- to 56-F daily mean base. This enables estimating monthly and seasonal loads within a few per cent.

A A Markson stated that throttling control of steam-jet cooling units saves about one-third in steam consumption. As condenser pressure is reduced by lower wet-bulb conditions, the booster jet has less head to pump against and a saving can be made by reducing steam pressure in supply to jet.

A new moderate-capacity absorption-refrigeration system using methylene-chloride as refrigerant and dimethyl ether of tetraethylene glycol as absorbent should be of interest to the district heating industry, according to J de B Shepard, as it operates economically on 10-lb pressure steam.

Officers for the coming year are G D Winans, Detroit, President; F L Witsell, Toledo, First Vice-President; and L S Phillips, New York, Second Vice-President.

Fire Protection for Air Conditioning

Air-conditioning systems are potential fire starters and spreaders. Protective equipment catches up and turns hazards into safety factors

By N D SHERWOOD
Rockwood Sprinkler Co, Worcester, Mass.

PRACTICALLY EVERY development towards increased efficiency in industry introduces fire hazards not contemplated when fire-protection or fire-extinguishing equipment was first installed in the property. The fire-protection engineer has to study characteristics of each new hazard.

This is a specialized job. One cannot rely on the hope that fire will not happen to strike at a given point or that someone will be close enough to extinguish flames quickly. Loss of human life may be the result of lack of forethought. New equipment must be developed. Existing, tried devices have to be adapted to the control of fires and panic hazards possible under new and more exacting conditions.

Air conditioning has contributed to the comfort of millions of people and has come to stay in our industrial, institutional, mercantile and amusement world. For many years, fire underwriters have insisted that buildings must be subdivided wherever practicable, both vertically and horizontally, by fire stops or fire walls. This insistence is the result of costly and bitter experience. Our annual fire loss has been greatly reduced by confining fires to comparatively small areas by fire doors and fire stops. Air-conditioning equipment breaks down this standard protection wherever ducts pierce fire walls and create shafts vertically throughout the building.

Air-conditioning equipment presents three inherent hazards: (1) fire "breeders" (2) fire "spreaders" (3) "exposure" fires. In addition to these, the panic hazard occasioned by the rapid circulation of smoke in public places has to be taken into account. Of only slightly less importance is the damage from smoke to property and contents.

The first requirement of a protective system is to extinguish a fire in a fire breeder (filter or other inflammable substance within the air-conditioning system itself). The second need is to remove the "spreader" hazard by automatically cutting off power to the fan motor and by closing dampers of fire doors in the air supply to the fan, the fresh air intake and possibly also the fan-discharge duct. Thirdly, automatically interposing a water curtain over the entrance to the fresh air intake blocks the entrance of an outside "exposure" fire.

The greatest fire breeder in air-conditioning systems is the air filter. In the past, practically all filters have been viscous coated to aid in the collection of dust, lint and impurities of various kinds. Coating and lint present a highly inflammable surface. Of several types now being perfected, at least two dry filters have been approved by the Underwriters Laboratories, Inc, as being incombustible. Dust accumulations on filters, however, are combustible, and means should be provided for extinguishing fires originating in or communicated to the filters.

For many years, presence of fire has

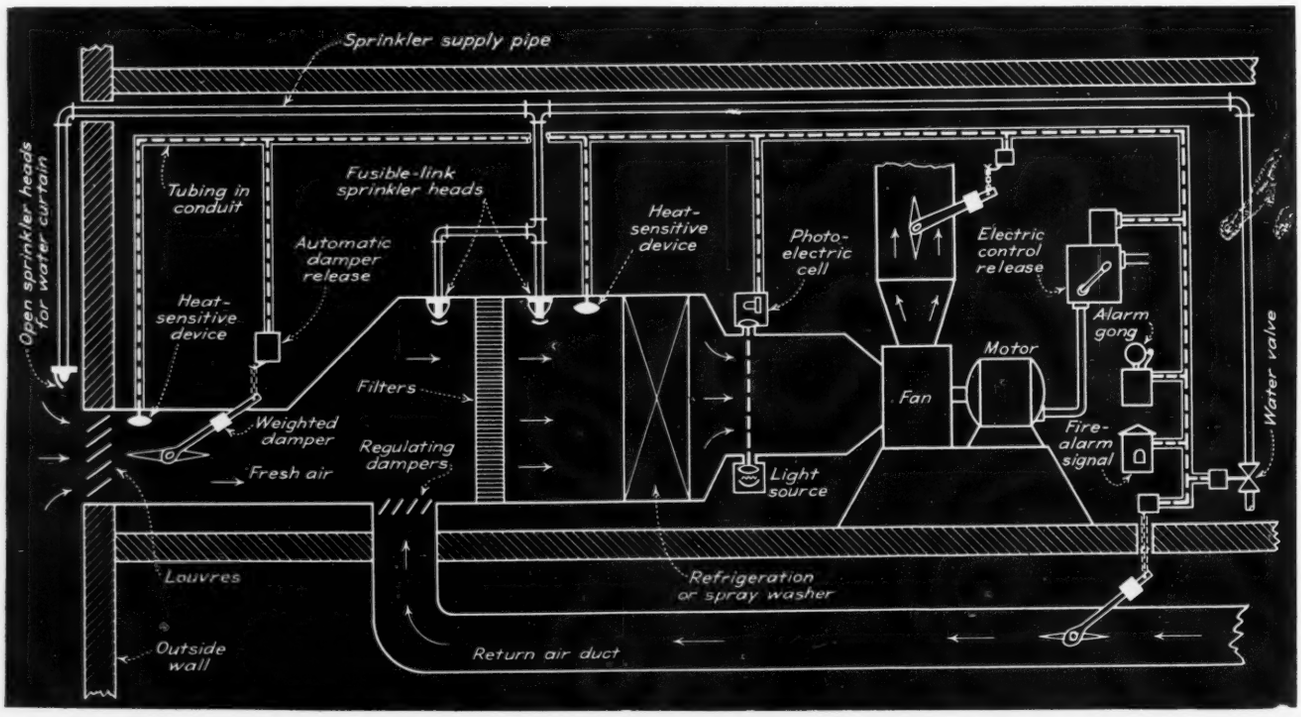


Fig. 1—Impulse from heat actuated devices or photo-electric cell trips damper latches, cuts motor switch, supplies water to curtain spray and rings alarm (Fusible-link sprinkler heads operate only if fire is communicated to filters)

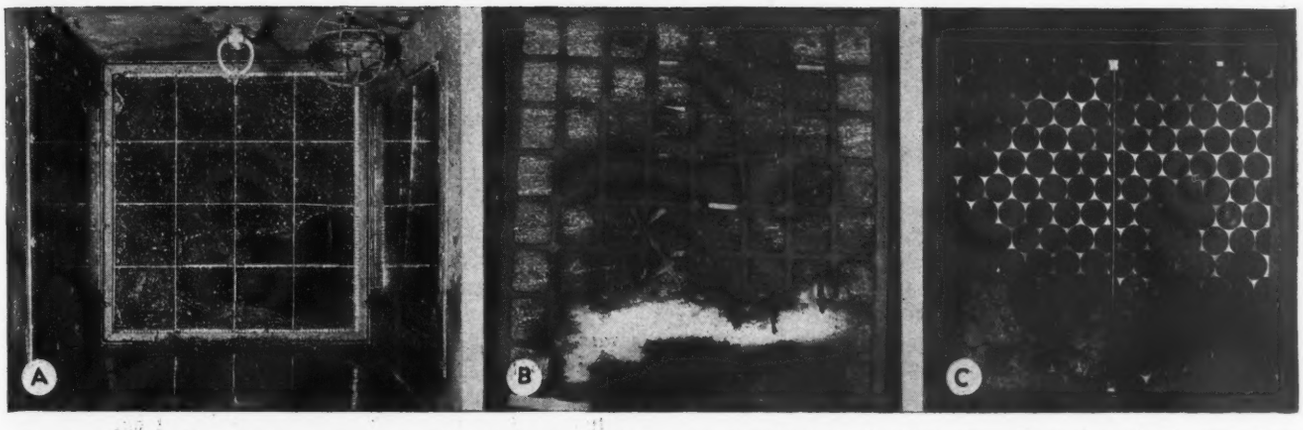


Fig. 2—Filters after fire has been drawn through long enough to set off sprinkler. A, oiled paper, B, steel wool, C, spun glass

been detected by (1) devices which function when a predetermined temperature has been reached and (2) by others which react to a temperature rise. Key element of the first type is usually a low-melting point alloy solder which can be varied in composition to melt at any temperature above about 130 F. The second type measures rate of temperature rise by expansion of an enclosed quantity of air.

One type of the latter equipment is simply a hollow metal chamber in which air pressure builds up when temperature starts to rise. Copper tubing connects one or several of these chambers to a sensitive diaphragm in a releasing mechanism which holds a weight in suspension. Pressure created in the chamber by normal variation in weather or other normal temperature rise is vented through an accurately calibrated orifice. This orifice is not large enough to vent the pressure created by a fire but avoids operation of extinguishing equipment during normal variations in temperature.

When a fire occurs, pressure created in the heat-detecting chamber is transmitted through the copper tubing to the diaphragm in the releasing mechanism, which drops a weight. The energy of the falling weight can be utilized to operate any type of fire-extinguishing or alarm equipment, close or open electric switches, dampers or valves.

This equipment is not newly developed and untried. A recombination of standard fire-protective equipment approved by the Underwriters and veteran of many fires has simply been applied to the special problems of air conditioning. A typical application is illustrated in Fig. 1.

Another new problem is the rapid circulation of smoke from a fire too distant or too small to generate appreciable heat. While the background of experience in smoke detection is not extensive, research of fire-protection engineers has demonstrated that it can be done satisfactorily by the photoelectric cell, more commonly called the "electric eye." As in the case of heat-detecting equipment, this existing and tried device has been used with other standard protective equipment. Only the combination is new.

Protective equipment consists of a combination of heat-detecting equipment of rate-of-rise and fixed-temperature types and an electric eye to operate apparatus for checking the spread of fire and extinguishing it.

Basic protection should embrace several operations. First, fans should be shut down by cutting off power supply if either fire or smoke is detected. At the same time, weighted dampers close to assure positive stopping of any further circulation of heat or smoke. Since no damage results from these operations, detection should be sensitive and rapid, erring in the direction of closing down the system for too slight a fire rather than waiting too long for more positive indication.

After the air-conditioning system has been rendered incapable of contributing to the spread of fire, extinguishing equipment should be ready to act, but under control of less sensitive devices which bring water into play only in the immediate area of actual fire. Automatic sprinklers with fusible heads accomplish this as they require the temperature to be maintained for a considerable period before they operate. They should be installed in a position to deluge the filters and any other known combustible material in the filter or plenum chambers. Number and location of heads vary as needed.

If the fresh-air intake can possibly draw in flame or smoke from a fire existing on an adjacent property, shovel-type open sprinkler heads are installed to provide a fire-impenetrable water curtain over the intake. These can be controlled by the same devices employed to shut down the fan or in

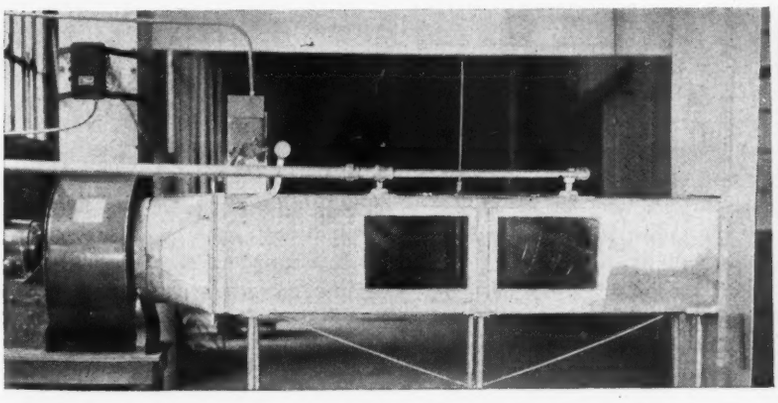


Fig. 3—Laboratory set-up of intake duct and fan where effects of filter fires are studied

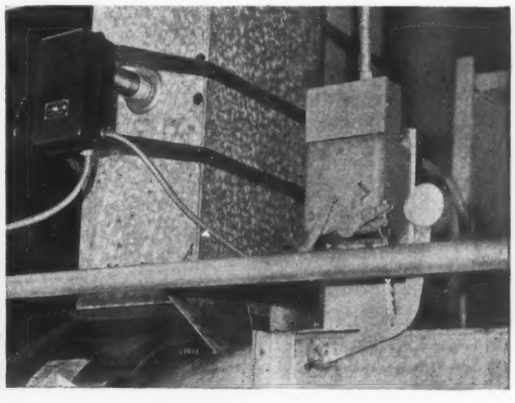


Fig. 4—Close-up of electric-eye installation and damper-release mechanism

a variety of other ways to suit individual cases.

Fusible-link sprinkler heads alone cannot be expected to protect filters while fans are in operation. Repeated tests have proved that the heat will be driven away from the heads directly over the fire. In this way, the heads most needed will not operate until the draft has been cut off.

Many refinements can be added to the basic system to suit special needs. For example, immediate operation of the fire-protection system can be provided from the rate-of-rise detector, additional heat and smoke detection can be installed outside the building or in other parts of the building. Gongs and water-driven sirens give local alarm or connection can be made to relay the alarm to Fire Headquarters. The first impulse of rate-of-rise detectors can be used to convert dry sprinkler systems to wet-type, thus bringing water right up to the sprinkler heads which may later have to operate.

Air-conditioning systems have already caused serious fires and considerable property damage. Large sums of money have been and are being spent in the study of the hazard and the development of equipment to control it. Each type of air-conditioning equipment requires special study and engineering. No rule-of-thumb procedure can be applied, as each individual system presents conditions which must be diagnosed before a cure can be prescribed.

Little has been said about the panic hazard, but it is very real. The human body cannot breathe in superheated air and live. The danger of loss of life from the heat of a fire being carried to all parts of a building is all too apparent. However, the history of fire-protection is filled with cases of special hazards studied and equipment adapted and invented to control them. Proper protective equipment for air conditioning is available, engineers are aware of the hazard and no technical bar interferes with truly fire-safe air conditioning in the future.

Towards Better Diesels

Engineers survey new trends here and abroad and tackle practical problems of economics, lubrication, piston-ring and liner wear, injection, and combustion, at the 12th National Meeting of the Oil and Gas Power Division, A S M E

ANN ARBOR, MICH., June 22, 1939—Surveying progress in diesel-engine development both in this country and abroad and tackling such practical problems as economics of oil and gas power, lubrication, piston ring and liner wear, injection and combustion, the 12th National Meeting of the Oil and Gas Power Division, A S M E, drew more than 200 engineers to the University of Michigan, Ann Arbor, for the four days from June 19 to 22. In addition to hearing 14 papers of technical interest, engineers attending the meeting had a chance to see the latest in diesel-engine equipment as exhibited by numerous manufacturers and to visit the new plant of General Motors Diesel Engine Division.

Most medium-speed heavy-oil engines built in Great Britain during 1938, for stationary use, were 4-cycle vertical units with solid injection and open combustion chambers, according to a paper by A K Bruce, of Robert Bruce and Sons, London. Use of supercharging by either exhaust-gas turbines or external blowers seems to be growing and Mr. Bruce's paper pointed out that this is particularly true in mining power plants with heavily fluctuating loads. Without increase in exhaust-gas temperatures, supercharging in such installations gives from 20 to 25% greater output.

English builders continue to produce horizontal engines, particularly in the vis-a-vis design. The largest stationary engine yet manufactured in Great Britain is a 2-cycle opposed-piston unit now in operation in Bermuda. Interest also attaches to the introduction, last year, of a line of 2-cycle blower-scavenged engines.

Fuel Situation in England

The fuel situation in England somewhat favors the gas engine and so development in this field has not been wanting. Designers give much attention to engines to run on either gas or oil without change in compression ratio, and by means of oil ignition. Work has also gone forward on the Erren engine, which uses spark ignition and oil ignition alternatively.

Stressing the great reduction in weight made possible by improvements in injection, better materials, and increased piston speed, a paper by Marcel Bochet, Société Als Thom, Paris, described several outstanding oil engine installations in Europe. Numerous design changes discussed by Mr Bochet have reduced weight from about 300 lb per hp, for units running at 100–300 rpm, to about 40 lb per hp for industrial and marine types and about 10 lb per hp for automotive types.

Paying particular attention to combustion-chamber design, C R Maxwell and C G A Rosen, Caterpillar Tractor Co, traced development of high-speed diesels in this country. That no single design yet dominates this field indicated to the authors that diesel development in the U S is still in its infancy and that all designs are being given a fair trial in service.

To make the Oil-Engine Power Cost Report more useful to the "forgotten man," the diesel user or prospective user, P H Schweitzer, Pennsylvania State College, presented a series of interpretive curves based on data from recent issues of the report. By separating lubricating-oil economy figures according to engine types and eliminating the effect of such factors as engine age, size, speed, and method of lube-oil treatment, Prof Schweitzer produced a chart showing probable lube-oil economy of newly purchased engines of

each type. A somewhat similar analysis produced a like chart for fuel-oil economy.

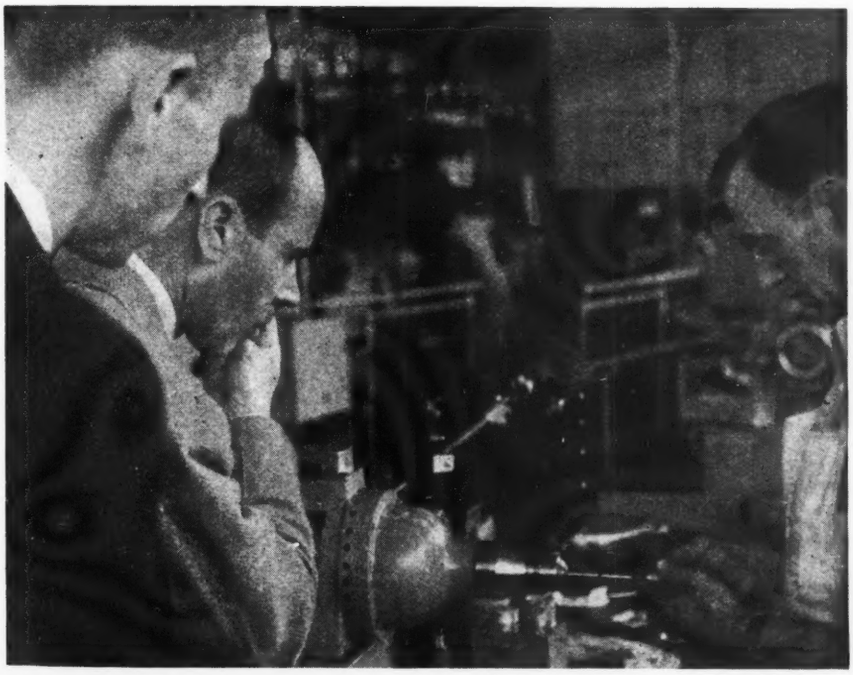
Discussion of Prof Schweitzer's paper turned around the advisability of interpreting the Oil-Engine Power Cost Report, which is intended to be a purely factual statement of actual operating results, and the consensus of opinion seemed to be that if interpretation were needed it should be entirely separate from the report, that is, in a paper such as Prof Schweitzer's.

Diesel Plus Utility Service

Feeling that little has been said about use of private diesel power combined with public-utility service, E J Kates, consulting engineer, New York, presented a comprehensive picture of the ways such combinations can serve both consumer and utility. Common applications are: (1) utility service as standby for diesel power, (2) diesel power as standby for utility service, (3) diesels to restrict maximum demand on utility service, (4) utility service to check diesel frequency and synchronous time, (5) utility service as auxiliary to diesel power, and (6) utility service to carry momentary load swings. Pointing out the lack of uniformity in present rates for standby service, Mr. Kates advocated a two-part rate based on a charge for standby protection (with full allowance for diversity) and a charge for actual use. Such a rate would allow diesel operators to take full advantage of ties with utility systems and would provide a fair return for the utilities. A full discussion of technical and economic factors involved in parallel operation between diesels and utility lines brought the paper to a close. An appendix gave statements outlining the position of several major utility systems with respect to parallel operation.

Charles Snyder, Monongahela System, pointed out that diversity, under a standby contract, was not felt by the utility until the plant was reached so that the company must receive compensation for the additional capacity in the distribution system needed to handle standby load. The same reasoning applies to consideration of diversity factor in use of utility power to handle diesel load swings. Mr. Snyder, Col. Oliver Field Allen, and Mr Kates all stressed the importance of a full engineering and economic analysis of each case where combined utility-diesel operation is contemplated.

A session on piston rings brought out a variety of opinions. Discussing the mechanism of wear, the characteristics of cast iron as a ring material, the question of decreasing width of ring face, effect of high temperature on rings, and design of special rings, J M Dodge, Double-Seal Ring Co., pointed out features which might be considered sound engineering practice. These included use of cast-iron as basic material, the possibility of future developments in rings made by combining two or more metals, the possibility that scientists might develop a metal or combination superior to cast iron, and the need for closer cooperation between engine and piston-ring designers.



Members watch a precision operation on an injection-unit part for a GM diesel

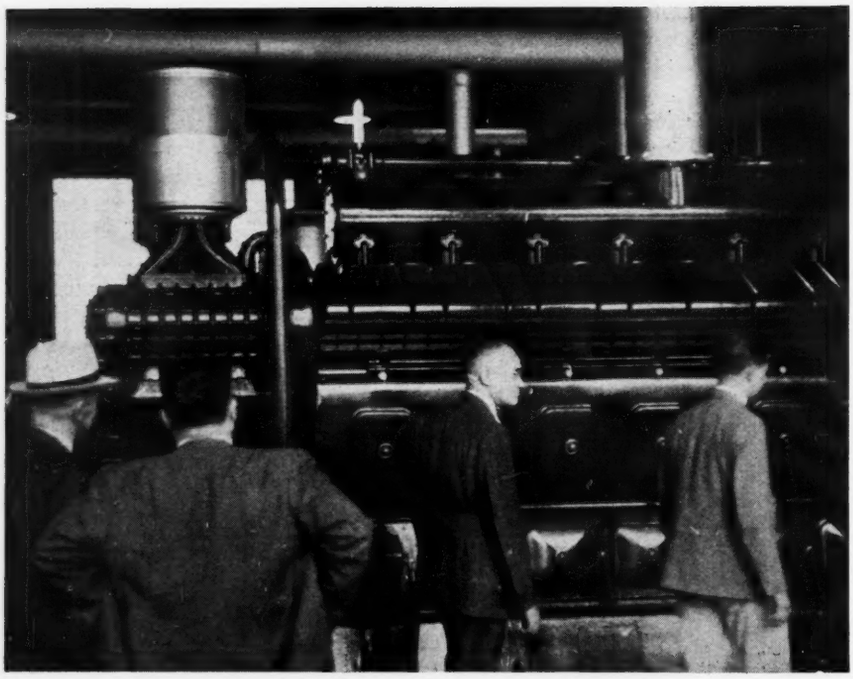
Considering wear mainly from the viewpoint of cylinder and ring materials, Paul S. Lane, American Hammered Piston Ring Div, Koppers Co, presented data from laboratory wear tests on a wide variety of ring and cylinder materials, showing effect of section size, hardness, analysis, and metallographic structure. Particular interest attached to test results on the effect of bore finish and surface treatment and to performance of bimetallic or composite rings. Mr. Lane concluded that proper balance between ring and liner materials may reduce wear considerably and that use of bimetallic or chemically-treated rings offers similar possibilities.

Piston Rings

Tackling the same general subject from a somewhat different angle, D D Cook, Cooktite Ring Sales Co, outlined the functions of piston rings and showed how design improvements reduced blow-by and prevented combustion carbon from filtering into ring grooves to cause sticking and impair crosshead lubrication. Special functions for diesel piston rings, such as transmission of heat to cylinder walls, and oil control, led to development of special rings for these purposes. Considering next the related matters of ring materials, surface treatment of cast iron, cylinder materials and wear, Mr. Cook summed up as follows: "Cylinder wear can be reduced materially by paying greater attention to piston-ring function and to the materials of which rings are made."

Bringing the symposium on rings to a close, Stuart Nixon, Sealed Power Co, traced growth of need for better ring performance, showing how spring tension was early recognized as an important factor. By means of mathematical analysis, Mr. Nixon's paper indicated limits encountered in design, showing that the controlling factor in ring tension is probably stress in the ring under operating conditions. Ring widths have been considerably revised in recent years and as a general thing have been made narrower to gain flexibility needed to seal under operating conditions of thermal and mechanical distortion. It cannot be said that ring life increases are entirely due to narrower rings, but they have not been detrimental.

In the active discussion following these papers, Ralph Miller, Superior Engine Co, emphasized the importance of corrosion-resistant materials in reducing cylinder liner wear, pointing out that chemical action is the major cause of wear, as shown by increased wear when light loads cause operation at low



Engineers find another highlight of inspection trip in laboratory and power plant of G M Diesel Engine Division. Here powerhouse and test-stand diesels, mg sets, and electric and oil-fired boilers are partners in a unique power-heat pool which supplies the adjoining factory (see Power, May 1938, for description)

temperatures. Similar opinions were held by E T Vincent, Michigan University, who cited data published by the Institution of Automotive Engineers, Great Britain. Mr Lane pointed out that corrosion-resistant materials frequently have poor wearing qualities but indicated that the trend to better surface finish will help in corrosion resistance as well as mechanical wear.

Lubricating Oil

To answer the question—"How can performance of lubricating oil be predicted?"—"When is an oil worn out?"—W F Weiland, University of Nebraska, developed a simple short-time test for oxidation and presented to the meeting results of experiments using this apparatus. Data showed that temperature, aeration, and presence of certain catalytic metals all increase oxidation as measured by Prof Weiland's "oxidation number." The work also indicated importance of formation of acid vapors, showing that temperature at which vapor forms decreases as oxidation progresses and that vapors harm common engine metals.

T H Rogers, Socony-Vacuum Oil Co, said that Prof Weiland's method was qualitative only and pointed out that his oxidation index depended mainly on asphaltine formation, only one of factors affecting oil stability. George Rounds, also Socony-Vacuum, stated that lab tests aren't the final answer and won't take the place of engine tests, since it is necessary to know what happens to the engine as well as to the oil. H M Rugg, Penn Grade Crude Association, outlined an extensive research program sponsored by the organization, and said that they disagreed with Prof Weiland on use of color as an index of oxidation. In Mr Rugg's work, pure oxygen is applied to minute fractions of oil to check all products of oxidation; the program also includes correlation of these laboratory tests with actual field data. E T Vincent, University of Michigan, cited a case to prove that temperature is not necessarily the most important factor in oxidation. He blamed oxygen in blow-by, but Prof Weiland pointed out that it is unnecessary to assume oxygen in blow-by since oil picks up much air as it gets churned around in the crankcase.

Prolonging Lube-Oil Life

Treating lubricating oil to prolong its useful life was considered in a paper by Paul Williams, Skinner Purifiers Co, read by James H Skinner. After describing principal systems of engine lubrication and most important points of application for lubricants, the paper indicated limits for such deterioration of oils as comes from changes in viscosity, acidity, water, and sediment, and pointed out the importance of regular oil tests to measure quality of oil. Having shown what oil conditions should be maintained, Mr. Williams outlined methods of keeping oil in condition, including cloth, waste, or earth filters, settling by gravity, chemical treatment with coagulants, centrifuging, edge filtration, and re-refining. He concluded by showing how the general design of an oil system could contribute to maintaining oil in desired condition.

Smoke in Exhaust

Using a foot-candle meter, tests run at University of Texas and reported in a paper by H E Degler, showed that with an engine having a precombustion chamber, timing had marked influence on smoke in the exhaust, as did load change and air intake vacuum. On the other hand, backpressure or exhaust pipe length, and cooling water temperature had little or no effect. Tests also show that high humidity tends to clear up smoke in exhaust. Major conclusion is importance of ignition quality as represented by cetane number.

P H Schweitzer stated that similar tests run at Penn State confirmed most of Prof Degler's conclusions and indicated that compression ratio is an important factor. Other discussion raised questions as to correlation between smoke-meter measurements and measurement by eye or other methods, and also to the effect or significance of smoke color.

Outlining the functions of a combustion chamber, V L Maleev, Oklahoma A & M College, traced the development of the main types of combustion chambers used in high-speed diesels, grouping them as follows: (1) precombustion chambers, (2) divided chambers fitted to produce turbulence, (3) open chambers, (4) chambers with air cells, and (5) chambers with energy cells. After discussing the characteristics of each, Prof Maleev presented an interesting tabulation in which various combustion chambers were compared with respect to 11 factors. Prof Maleev concluded from the survey that for high-speed engines there is a trend away from quiescent chambers to those featuring turbulence. But application of supercharging may change this picture, bringing designers back to the open chamber.

Injection Systems

Indicating that most changes in injection systems during the past 20 years have come from improvements on old systems rather than from development of new ones, E T Vincent, University of Michigan, described each of the major systems. He concluded that injection system improvement is relatively unimportant in determining overall engine efficiency but that differences in injection systems cause great differences in maintenance and operation.

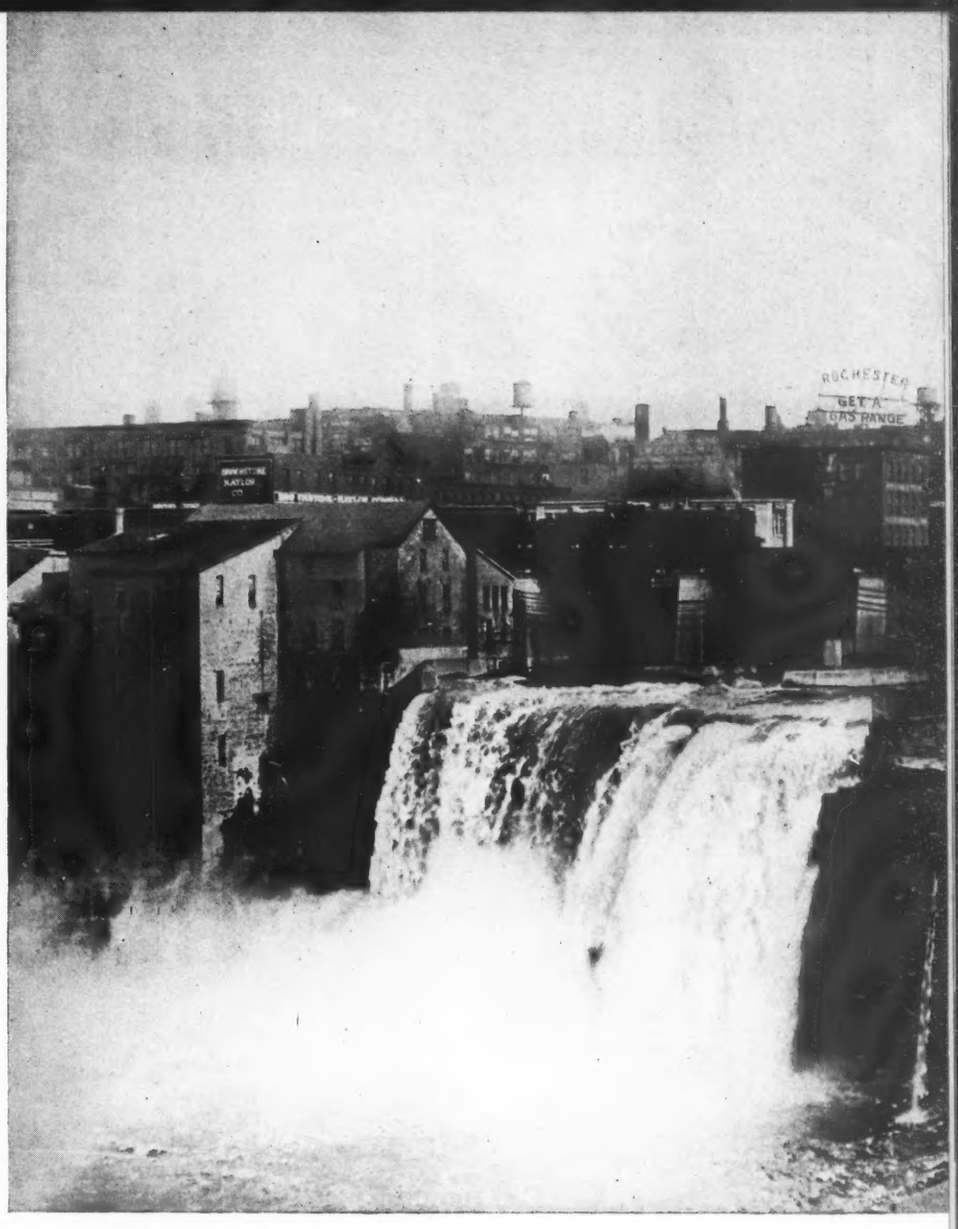
45 YEARS on the LINE

BACK about 60 years before TVA (1870 Republican time), a water wheel was installed at the base of the Upper Falls, Genesee River, Rochester, N. Y. Power transmission in those days was no simple matter, for the wheel was connected by a rope drive to a line shaft 80 ft above the wheel.

To top it off, the line shaft, 1500 ft. long, ran through the basements of a number of buildings, from where about 50 to 100 small industrials took off their power by pulleys and belts. It took 300 hp, or 50% of the power generated by the wheel, to drive the shaft.

Then in 1894 came the revolution and four bipolar direct-current generators were put in. The old water wheel still drives the two generators shown in the photograph on page 96, but they are operated only when there is a good flow of water in the river. The Rochester Gas & Electric Corp took over the plant about 1893 (now known as Station 4) and operated the line shaft until the bipolar generators were installed. These bipolars were rated 150 kw each and weighed 17 tons. Of the two still in operation, one has its original commutator.

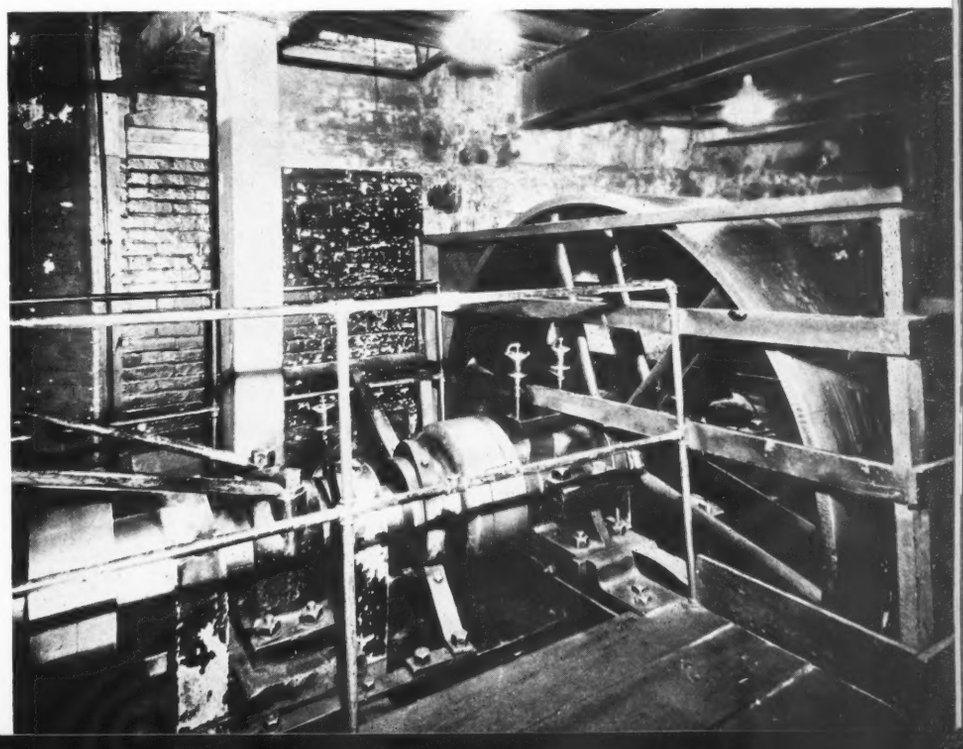
And just recently, Rochester Gas & Electric put in a GE, 25,000-kva, hydrogen-cooled, alternating-current, steam turbine-generator. Part of its power is converted to direct current and operated on the same bus with power generated by the bipolars. Photos courtesy of H C Ward, Rochester office, General Electric Co.

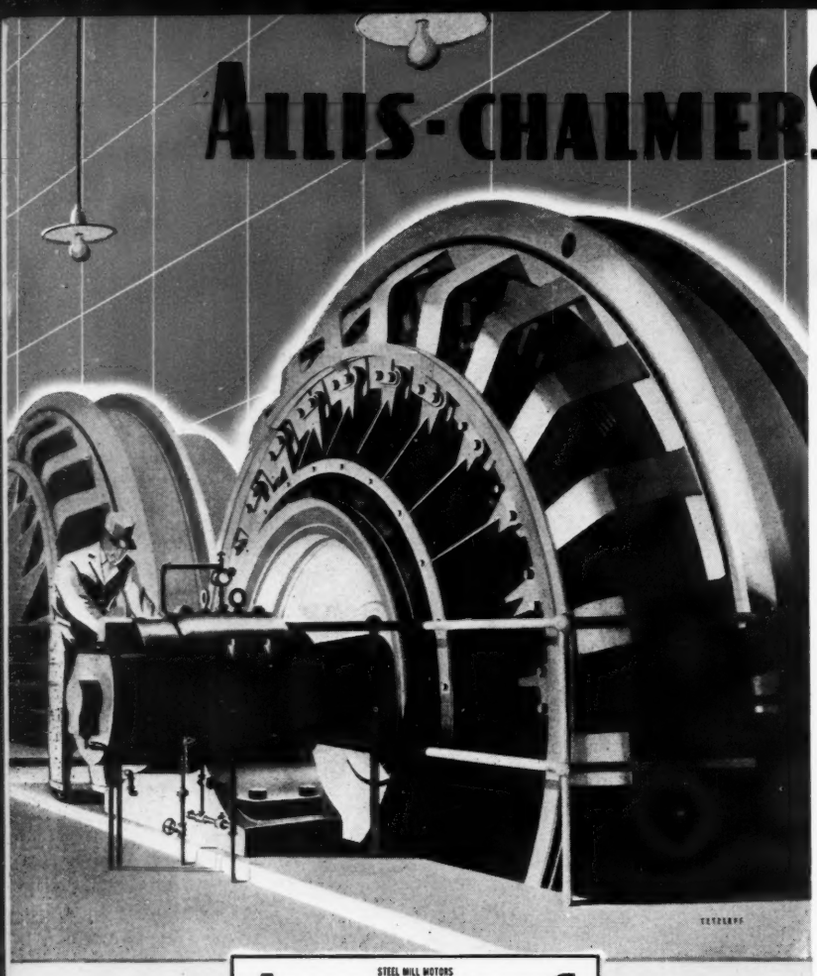


Station 4, Rochester Gas & Electric Corp, from east side of Upper Falls, Genesee River

CONTINUED ON PAGE 96

Drive pulley and jaw clutch for driving the 1500-ft shaft, machined only at the bearings





ALLIS-CHALMERS brings their own 2-150,000 lbs./hr.

Allis-Chalmers Manufacturing Company is pre-eminent among the country's leading industrial organizations. It manufactures Motors, Generators, Transformers, Switchgear, Voltage Regulators, Rectifiers, Electric Railway Traction and other Electrical Machinery; Steam and Hydraulic Turbines; Steam, Gas and Oil Engines; Condensers; Pumps; Blowers and Compressors; Crushing, Grinding, Metallurgical and Cement Making Machinery; Flour and Cereal Mill, Saw Mill and Power Transmission Machinery; Wheel and Crawler Tractors; Tillage, Planting, Harvesting, Threshing and Road Machinery; Timber Preserving and Coal Distillation Machinery; Electric Mine Hoists; Tunnel Shovels; Forgings, Castings and Plate Work; "Akon" Boiler Feedwater Treatment; Tex-rope drives.

To reduce the cost of producing steam Allis-Chalmers Manufacturing Company decided to replace 3-625 H.P. and 1-717 H.P. stoker fired boilers. After a most thorough investigation of modern installations, 2-150,000 pound Riley Steam Generating Units fired with Riley Pulverizers were selected.

What better evidence of the satisfactory performance of Riley units than for a company with the tremendous engineering experience of Allis-Chalmers to install these units in its own plant. The correctness of this decision has been well proven by the excellent results which have been obtained. The units have given trouble-free operation at efficiencies between 84 and 86% and while guaranteed to produce only 150,000 pounds per hour, one unit has been operated at capacities as high as 180,000 pounds.

These Riley units were installed in an existing boiler house under extreme space limitations as is evident from a study of the accompanying photographs.

As is invariably the case with Riley units, the units were placed on the line without the annoying and costly difficulties so often encountered when a unit of this size is placed into operation. Below is a chronological study of the Allis-Chalmers job.

February 1, 1938	• Contract date
August 25, 1938	• Boiling out of unit completed
September 5, 1938	Placed on line at moderate loads
September 9, 1938	Shut down over week-end for inspection
September 14, 1938	Unit placed on line
September 20, 1938	Carrying full load

So with surprising ease these two Riley units were placed into satisfactory service, adding another well-known name to the rapidly growing hosts of Riley boosters. Riley has climbed so rapidly to a position of leadership in the boiler industry because results from Riley equipment have surpassed accepted standards of operation.

Investigate some recent Riley installations and see for yourself how well Riley can serve you in meeting your most exacting requirements.

STEEL MILL MOTORS

ALLIS-CHALMERS

AUGUST - 1939

SUN	MON	TUE	WED	THU	FRI	SAT
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

JULY - 1939

						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23/30	24/31	25	26	27	28	29

SEPTEMBER - 1939

					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30

TRADE MARK Rx REGISTERED

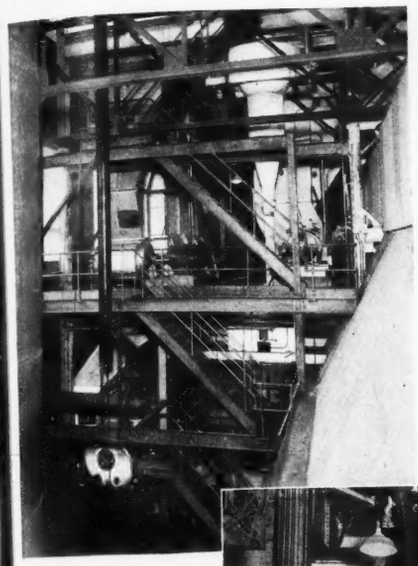
RILEY

STOKER CORPORATION, WORCESTER, MASS.

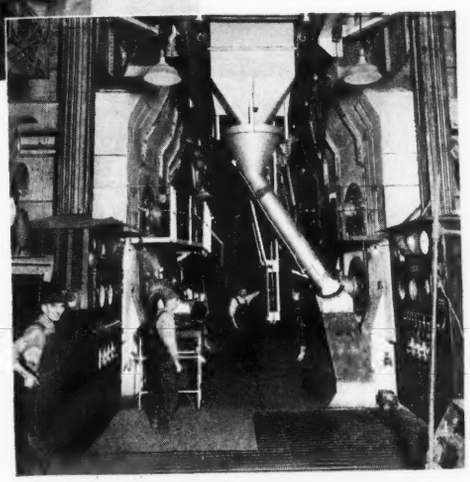
Boston New York Philadelphia Pittsburgh Buffalo Cleveland Detroit Tacoma Baltimore Milwaukee Denver St. Louis Cincinnati Houston Chicago St. Paul Kansas City Los Angeles Atlanta Memphis New Orleans

It will pay you to visit modern Riley Installations

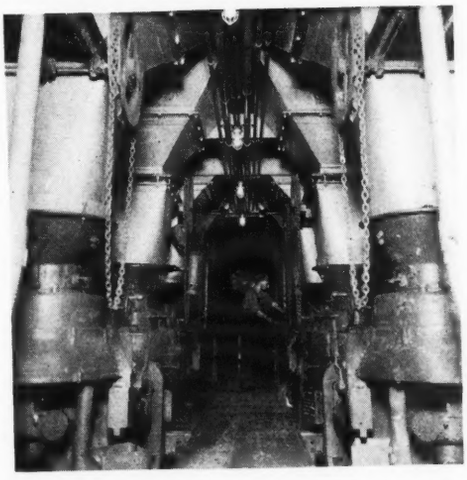
boiler plant up to date by installing
RILEY STEAM GENERATING UNITS



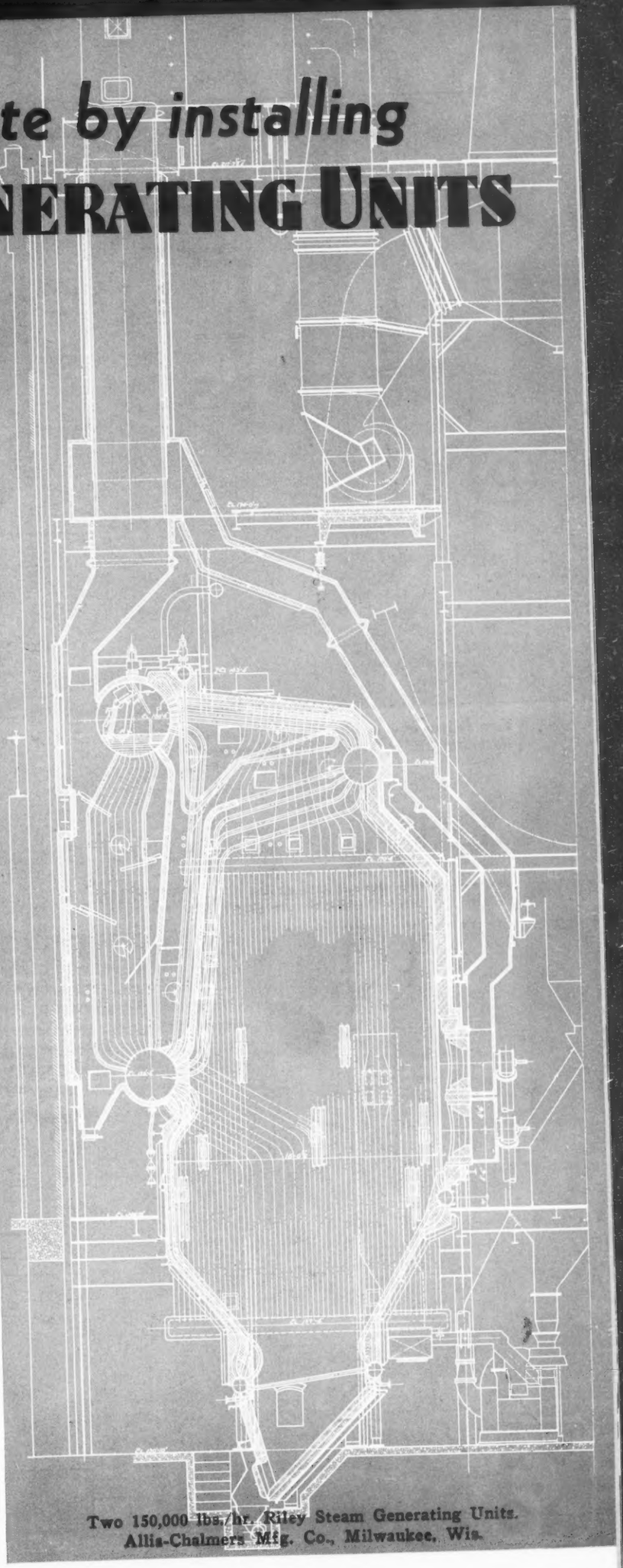
Fan Floor showing
F. D. & I. D. Fans



Firing Floor
showing
Riley Burners



Basement
showing
Riley Pulverizers



Two 150,000 lbs./hr. Riley Steam Generating Units.
Allis-Chalmers Mfg. Co., Milwaukee, Wis.

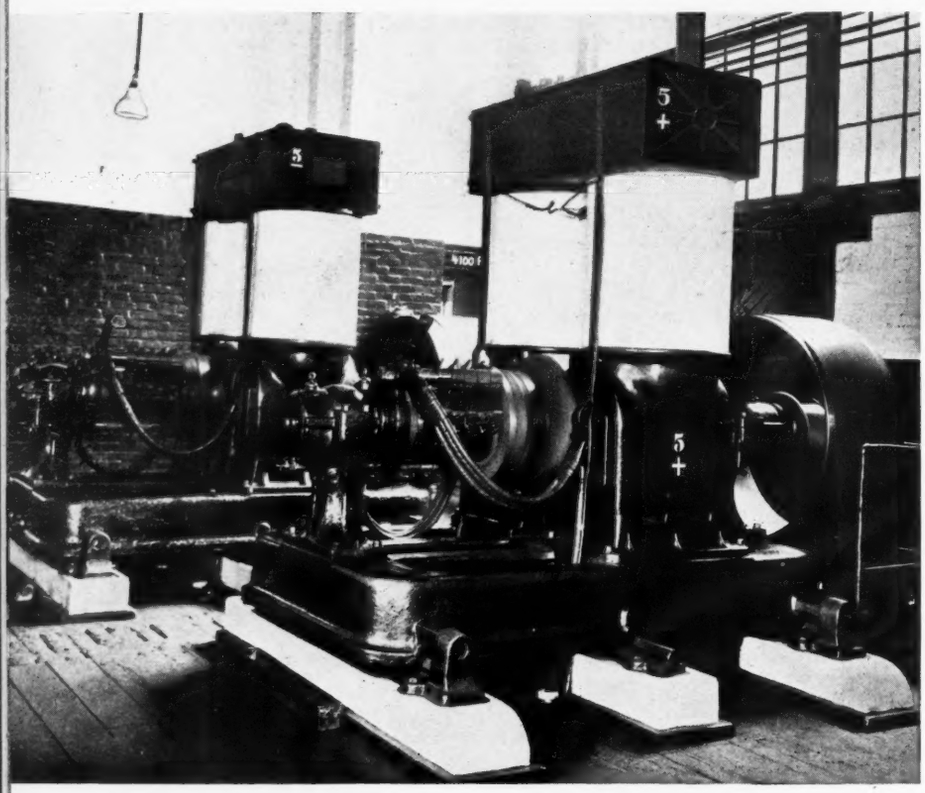
A survey of your power plant by a consulting engineer will possibly show ways of making surprisingly large savings in power costs.

BOILERS • PULVERIZERS • BURNERS • STOKERS • SUPERHEATERS
AIR HEATERS • ECONOMIZERS • WATER-COOLED FURNACES
STEEL-CLAD INSULATED SETTINGS • FLUE GAS SCRUBBERS

before purchasing Boiler or Fuel Burning Equipment

CONTINUED FROM PAGE 93

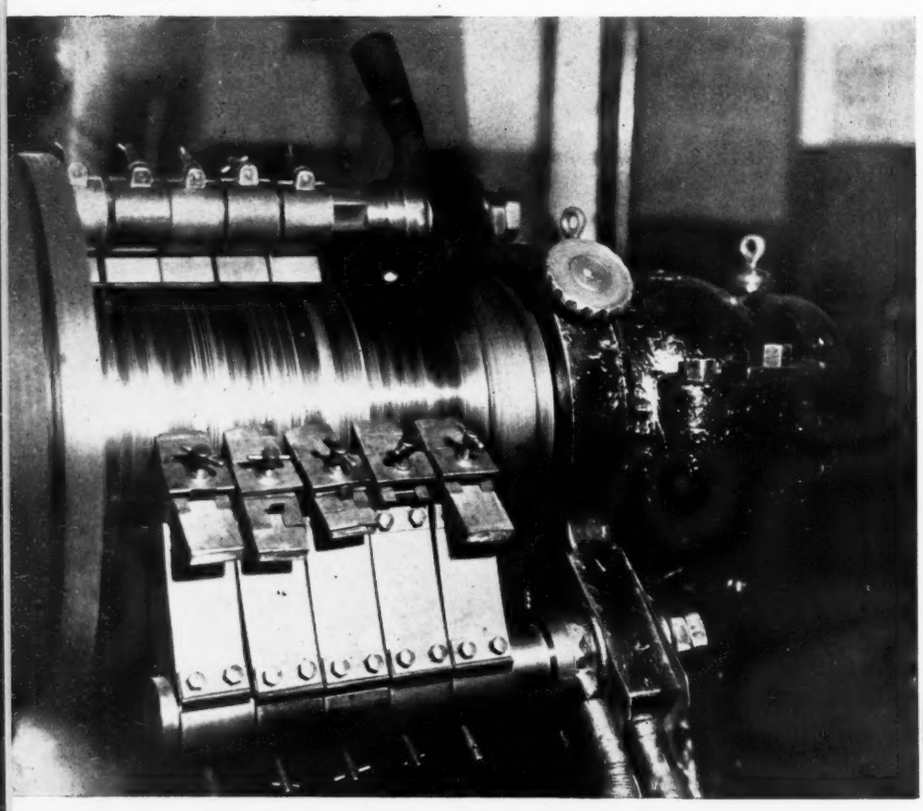
45 YEARS ON THE LINE



Two Edison bipolar generators, 150-kw each, installed in 1894 at Station 4, Rochester Gas & Electric, and still in use

Leonard V Begg, foreman of Station 4 for the past 40 years, started work in April, 1894, on what was called "the motor route", making regular calls to adjust brushes on customers' apparatus

Original commutator on one of the two Edison bipolars still in service at Station 4. Note copper-gauze brushes



THE OPERATING ENGINEER

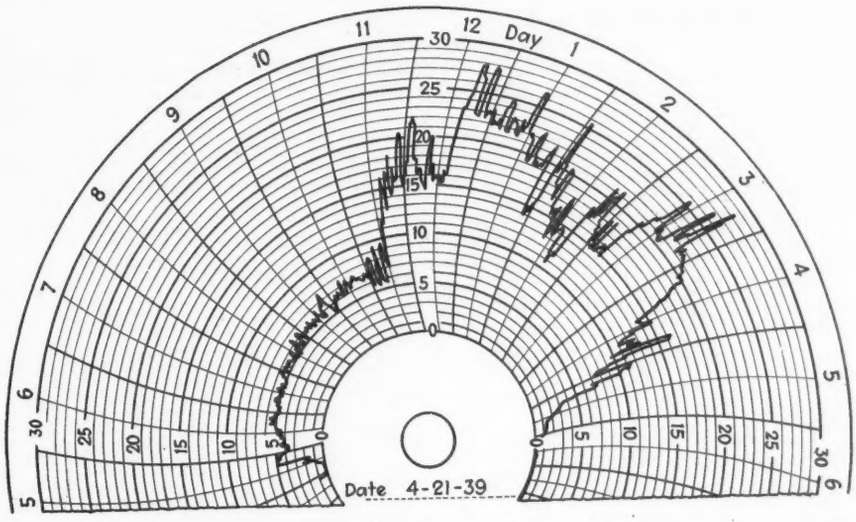
George Edwards
Advisory Editor

Practical Aids
Maintenance Hints
Questions — Answers

Published monthly as an integral part of POWER

Big Boiler in Small Space

Rochester Dairy Co solves boiler-plant problem with low-headroom unit able to handle wide load swings. Modernization takes care of load growth, saves about 15-20% in fuel

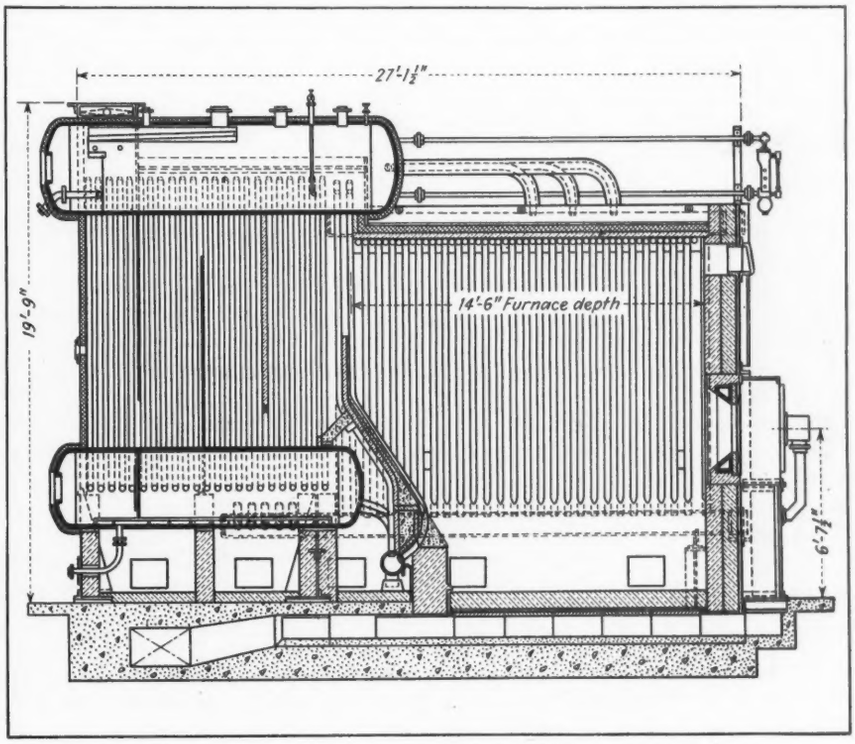


1. Boiler and controls have to handle this load

SOME TIME or another, every operating engineer faces the job of replacing old boilers with new. Offhand this sounds like a pretty pleasant job; something like the way it used to feel to run down to the candy store with a penny and a small boy's appetite. But that appetite and a small boy's big ideas always made it hard to decide just how to spend the penny. And the engineer runs into the same snag.

Somehow or other he's got to fit his ideas into a budget—usually a tight one at that. He learns fast. If he's smart, he only spends as much as load factor and general conditions justify, but he gets a full dollar's worth of capacity and efficiency for every dollar spent. Once he's licked a job like that, the second one comes easy—or should anyway. Trouble is, it's only the lucky operating engineer who gets a chance to tackle a modernization job with experience under his belt. Best bet for the man who's still waiting is to learn from other people's experience.

For example, take a look at the Rochester Dairy Co's new boiler plant at Rochester, Minn. They distribute bottled milk and cream and process milk into a wide variety of products. The bottled milk business takes some



2. Putting furnace ahead of convection surface saves headroom

steam, but not much, for pasteurizing, bottle washing, and cleanup. It's condensing and powdering milk that really takes steam—about one pound of steam for every pound of water evaporated from milk. Bakers, ice cream and candy manufacturers use the products: plain and sweetened condensed milk and dry milk solids.

Like most dairies, steam load is far from constant. Day to day changes come from differences in total amount of milk handled, but mainly from changes in split-up between bottling and processing. Even a small increase in amount of milk evaporated means a big steam increase due to heavy steam needs of this department. And when operators open up a couple of vacuum pans, load may jump 10,000 lb per hr in an instant, and fall back again right afterwards.

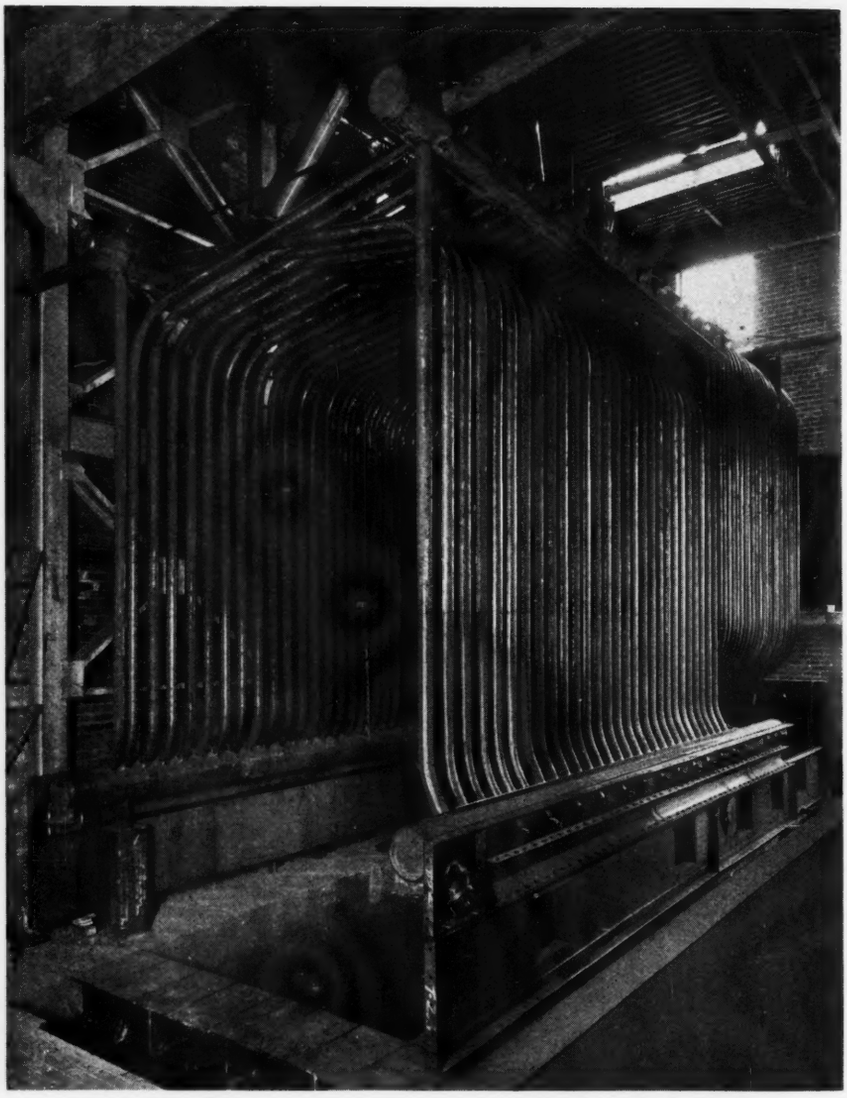
Until recently, two 800-sq-ft hrt boilers, originally fired by screw-feed stokers and later fitted with natural gas burners in front wall over stokers, and a 2000-sq-ft, 4-drum, bent-tube boiler, fired by gas without auxiliary fuel, supplied steam at 160 lb for the dairy. Part of the steam went straight to process and part to a 200-kw back-pressure turbine. Operators loaded this unit according to need for exhaust steam; additional power came from local municipal utility.

Load Grows

Early in 1938 it began to look as if more boiler capacity was absolutely necessary. Load had grown and frequently repeated peaks forced operators to run all boilers at high capacities and with high exit-gas temperatures. This pulled average efficiencies, with natural gas, down to 60-65%. What's more, all furnaces were small, and it was easy to see that further increase in load would be met with lower and lower efficiency or maybe not at all.

Specifications for the new boiler ran something like this: able to burn gas or coal; big enough to take care of entire load (about 25,000 lb per hr); able to handle heavy load swings; and to require little headroom. The cross-section shows the boiler chosen, a 2-drum Riley unit with fully water-cooled furnace fitted with combination gas and pulverized coal burner.

This design meets headroom limitations without loss of furnace volume, by putting the furnace ahead of the convection section, instead of under it. Picture taken before casing the boiler shows waterwall arrangement. Sidewall tubes, 3¼-in. on 6½-in. centers, run from lower sidewall headers to upper sidewall header on opposite side.



3. Sidewall tubes cross at top to form water-cooled roof

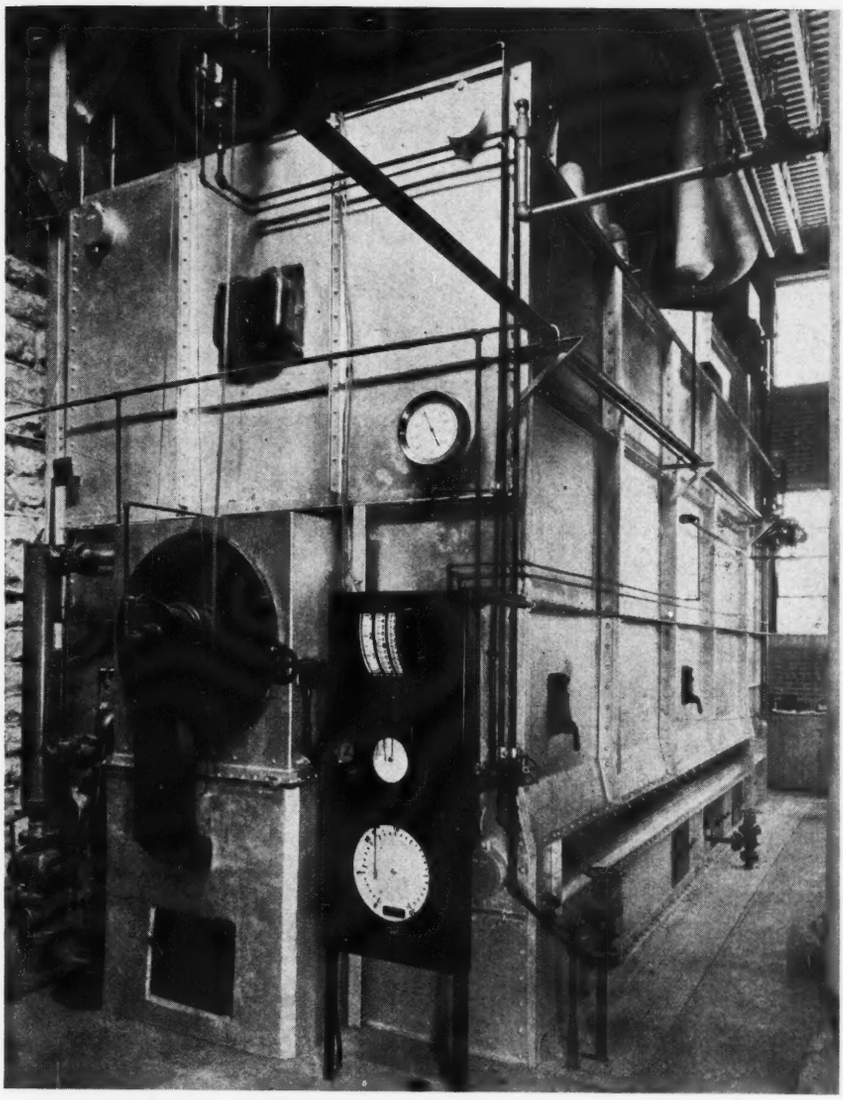
Crossing tubes at top forms a completely water-cooled roof.

A screen of tubes running from an auxiliary header to the upper drum separates furnace from the convection section; refractory between lower section of screen tubes forms a bridgewall (see section). Gas leaves furnace at about 1900 F and makes four passes vertically through convection tubes. Last pass is really a built-in economizer. Feedwater enters a partitioned-off space in rear of upper drum, makes one pass down to lower drum, and a second pass back to the upper drum before entering main boiler circulation.

This boiler unit carries out on a small scale the design ideas common in large power-plant boiler design, namely, efficient use of a fully water-cooled furnace; reduction of convection surface to much lower proportions than in older designs; and addition of enough heat-recovery to maintain over-all efficiencies at high capacities.

A forced-draft fan (Buffalo Forge) discharges air into a duct below the floor of the unit. This floor, made up of hollow building tile, refractory lined, carries combustion air to a plenum chamber in front. The refractory front wall mounts the combination burner—a standard Riley pulverized-coal unit fitted with a chrome-moly gas ring. A large number of stainless-steel nozzles provide for efficient distribution and mixture of gas and air. Right now, gas carries the load, but with this equipment operators can fire pulverized coal or gas in combination, depending on future conditions.

For all its compactness, housing this boiler took a little ingenuity. To build the extension wing needed meant removing a brick base supporting a guyed steel stack at about roof level of existing buildings. Building a structural-steel frame around stack base, with columns located approximately at new building outline, kept stack in service for other boilers while brick base was torn down.



4. Gas- and air-tight casing makes boiler shipshape

Completed boiler is a shipshape job, as photo shows. Aside from adding to looks, the steel casing is gas tight and air tight. It covers ship-lap tile and 4½ in. of insulation, a combination that helps keep heat in boiler where it belongs.

Automatic controls handle combustion. Panel in front of boiler mounts a Hagan steam-pressure and steam-flow actuated master controller. This unit sends out pressure impulses to a power cylinder mechanically connected to a balanced gas-admission valve, and to the boiler outlet damper. By this means, controller regulates fuel and gas flow from furnace to keep them in step with load changes. Air flow into furnace depends on furnace vacuum. A controller, mechanically connected to the vanes on the forced-draft-fan louvres, regulates air flow to maintain the proper vacuum in furnace. A constant-speed motor drives fan.

A 6-ft steel stack, 135 ft high, carried on a steel frame at boiler house roof, provides uptake draft. Stack is guyed at two intermediate points.

First year's operation shows this to be the right boiler for the job. Exit-gas temperatures hold below 500 F in spite of heavy loads carried; efficiency runs about 80% for loads up to 20,000 lb per hr and 78% at 25,000 lb per hr. This means real fuel savings, but exactly how much nobody knows. Double load variation, due to quantity of milk handled and split between bottling and processing, makes it practically impossible to compare today's fuel bills with yesterday's. Based on gain in efficiency, with allowance for load differences, fuel saving looks to be 15–20%.

But fuel saving is only part of the story. Important feature is having boiler able to handle any and all loads. Rated capacity of 25,000 lb per hr is ample for present and near-future loads, with old boilers available as standby. New boiler meets heavy load swings with little variation in water level; large quantity of steam produced in waterwalls enters upper drum above water line, through steam releasers. The result is steam of good quality even at high capacity.

Rochester Dairy operates with about 50–60% makeup; feedwater runs high in bicarbonate hardness. Operators have no trouble, however, in maintaining satisfactory conditions without pretreatment, depending entirely on internal soda ash and sodium phosphate feed. With this treatment they can run two to three months without cleaning.

Operation of plant is in charge of Mr Hair, Chief Engineer, under supervision of J M Punderson, general manager, Rochester Dairy Co. General engineering and construction of new boiler plant was handled by Fuel Economy Engineering Co, St. Paul, Minn, under direction of the Rochester Dairy Co.

✦ ✦ ✦

GO-CART —— Back home, darkies used broken-down go-carts for everything from hauling pickaninnies to hauling coal. When they had to go, they had to go—and there's nothing better to go with than a go-cart. But we've just found a new one, a go-cart for the boiler-room. And, believe it or not, it's carrying our old friend the orsat. It carries all the fixin's too, and may be the way to *make* that fireman take his gas samples like he ought to. What gets me too, is that Chief Naylor, who thought this one up, even put a drawer on it, "for whatever you want to put in it." That's my idea of something—a baby buggy with spare drawers!

Besides that, we've rounded up a story on a swell little dairy in Rochester, Minn., some more practical aids, answers to readers' problems, questions and answers, some more headwork from Phil Swain, and the lowdown on socketing wire-rope ends. I think you'll like these.

By the way, all the comments on this job so far have been enthusiastic. If I'm gonna be an editor, I've got to kick about something, or kill something. Well, what shall it be?

George Edwards

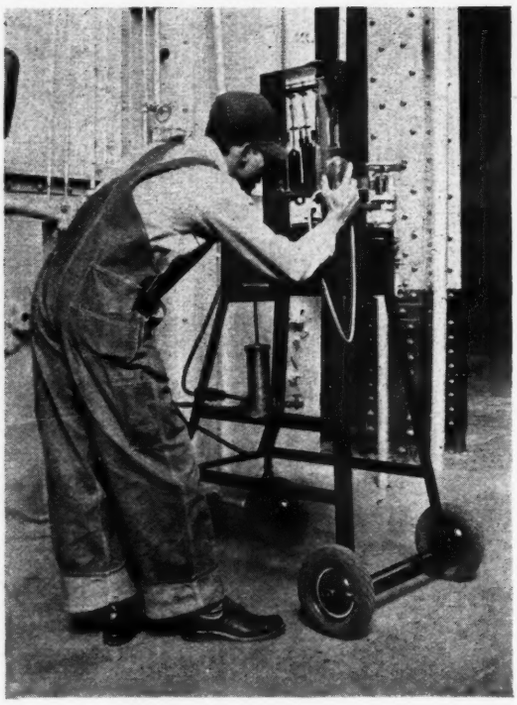


Fig. 1 — Location of pump and liquid bottles at just the right height adds to portability feature

By H. M. NAYLOR

THIS ORSAT Goes Places

Wheels and a pump don't cost much but sure help get more readings quicker. Here are the plans

CONSISTENT USE of the old familiar orsat does much to make up for lack of recording or indicating meters. Many plants have to get along with portable apparatus, success of which depends a lot on how frequently and how carefully it is used.

With its usual rubber aspirator, or even with a pair of rubber-stoppered sampling bottles, the orsat is about as unhandy a thing to tote around a plant and set up to operate as could be devised. In these days of lengthy sampling lines, the rubber aspirator takes so long to get a true sample that it gets to seem like filling up the stoker hopper with a coal hod.

Putting the orsat on a dolly takes the "getting started" out of the flue-gas sampling job. Everything is in one place and reaches the boiler at about the same time as the analyzer himself. This was never true of the "assembly in place" method. And a man-size pump cuts the time-wasting preliminaries down to a reasonable point.

The pump illustrated came mostly from the scrap pile. The cylinder started life as a bronze pump-sleeve. Ends of a cast-brass billet became cylinder heads after a bit of machine work. Base head has two holes bored radially for suction and discharge ports. They enter an axial hole bored only part way through. Suction- and discharge-valves are ¼-in. brass low-pressure check valves attached to the base head with all-thread nipples.

The filter is a 4-in. piece of 1-in. pipe filled with cotton and capped. A plug cock ahead of the orsat serves as a vent when the sampling line is to be purged.

The dolly wants to be made once-for-all so that the orsat is at a convenient height. That means several inches taller than the average table. Pump and accessories want to be convenient and a place provided for pencil, paper and data board. If two of the wheels are castered, the dolly will go where the pusher, not it, pleases.

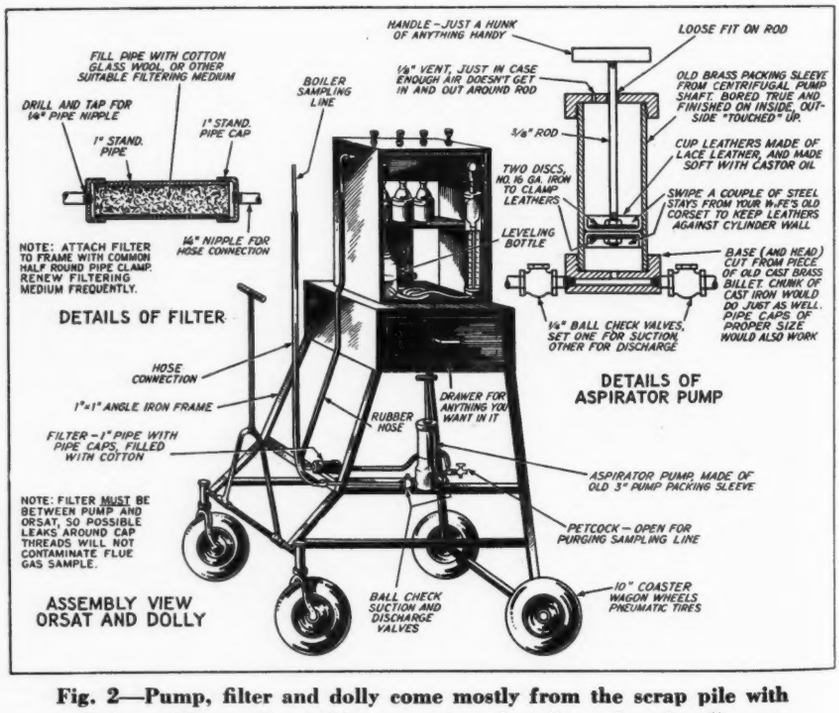

HANDLE – JUST A HUNK OF ANYTHING HANDY
LOOSE FIT ON ROD
FILL PIPE WITH COTTON GLASS WOOL, OR OTHER SUITABLE FILTERING MEDIUM
BOILER SAMPLING LINE
⅛" VENT, JUST IN CASE ENOUGH AIR DOESN'T GET IN AND OUT AROUND ROD
OLD BRASS PACKING SLEEVE FROM CENTRIFUGAL PUMP SHAFT, BORED TRUE AND FINISHED ON INSIDE, OUTSIDE "TOUCHED" UP.
DRILL AND TAP FOR ¼" PIPE NIPPLE
1" STAND. PIPE
1" STAND. PIPE CAP
⅜" ROD
CUP LEATHERS MADE OF LACE LEATHER, AND MADE SOFT WITH CASTOR OIL
TWO DISCS, NO. 16 GA. IRON TO CLAMP LEATHERS
SWIPE A COUPLE OF STEEL STAYS FROM YOUR W-F'S OLD CORSET TO KEEP LEATHERS AGAINST CYLINDER WALL
LEVELING BOTTLE
¼" NIPPLE FOR HOSE CONNECTION
NOTE: ATTACH FILTER TO FRAME WITH COMMON HALF ROUND PIPE CLAMP. RENEW FILTERING MEDIUM FREQUENTLY.
BASE (AND HEAD) CUT FROM PIECE OF OLD CAST BRASS BILLET. CHUNK OF CAST IRON WOULD DO JUST AS WELL. PIPE CAPS OF PROPER SIZE WOULD ALSO WORK
DETAILS OF FILTER
¼" BALL CHECK VALVES, SET ONE FOR SUCTION, OTHER FOR DISCHARGE
DETAILS OF ASPIRATOR PUMP
HOSE CONNECTION
1"×1" ANGLE IRON FRAME
DRAWER FOR ANYTHING YOU WANT IN IT
RUBBER HOSE
FILTER – 1" PIPE WITH PIPE CAPS, FILLED WITH COTTON
ASPIRATOR PUMP, MADE OF OLD 3" PUMP PACKING SLEEVE
NOTE: FILTER MUST BE BETWEEN PUMP AND ORSAT, SO POSSIBLE LEAKS AROUND CAP THREADS WILL NOT CONTAMINATE FLUE GAS SAMPLE.
PETCOCK – OPEN FOR PURGING SAMPLING LINE
ASSEMBLY VIEW ORSAT AND DOLLY
BALL CHECK SUCTION AND DISCHARGE VALVES
10" COASTER WAGON WHEELS PNEUMATIC TIRES

Fig. 2—Pump, filter and dolly come mostly from the scrap pile with a little welding and machining, and a few "store-boughten" parts

Watertube Boilers

by Harry Spring

Q—What is the difference between a watertube and firetube boiler?

A—The products of combustion pass through the tubes and the water passes around the tubes in firetube boilers. The reverse is so in watertube boilers.

Q—What short nipples are used in the B&W boiler?

A—Mud-drum nipples are used between the mud-drum and the bottom of each rear header.

Q—Why are baffles used in a watertube-boiler setting?

A—To deflect the hot gases back and forth between the tubes a number of times so that there will be greater heat absorption by boiler tubes.

Q—How is a new tube put in position for installation in a Wickes vertical watertube boiler?

A—Through one of the hand-holes provided for this purpose in the upper head of steam drum.

Q—What type of firing door is required on watertube boilers? Why?

A—Doors should be inward opening or be provided with self-locking door latches of a type not using springs or friction contact, so that the door will not be blown open in case of tube rupture or gas explosion.

Q—Where, other than tube caps, are handholes required in sinuous-header boilers?

A—In the external mud-drum.

Q—What three types of mud-drums are there in straight-tube watertube boilers?

A—The internal mud-drum as in the Heine boiler; the external mud-drum as under rear headers of a B & W boiler, and the lower (water) drum of a Wickes vertical watertube boiler.

Q—Are watertube boilers supported by the brick side-walls?

A—No. They are supported by steel work independent of the side-walls.

Q—Are stay bolts required in a sinuous-header boiler?

A—No.

Q—Where is the man-hole in horizontal watertube boilers?

A—In a dished head.

Q—What is the customary method of forming the man-hole frame?

A—The head is flanged in and if it is not at least $\frac{11}{16}$" thick for a gasket-bearing surface, a steel band is shrunk on the flange to bring it up to thickness.

Q—What would happen if a baffle broke in a watertube boiler?

A—Gases would short circuit one pass resulting in a loss of efficiency and capacity. Overheating and damage might result to parts of boiler designed for lower gas temperatures.

Q—What is an external mud-drum for?

A—It provides a chamber where sediment may be deposited out of the rapid water circulation. Sediment is then removed by blow-down.

Q—May butt straps or reinforcing doubling plates on a tube ligament be exposed to radiant heat?

A—No. They must be protected by brickwork or baffling.

Q—Of what are mud-drums of external B&W type made?

A—Wrought or cast steel.

Q—Where is the external mud-drum of a box-header boiler?

A—There is none.

Q—Can a ligament be strengthened on a boiler in the field?

A—Yes, by removing the tubes and riveting on a doubling plate.

Q—Are tubes beaded or flared in straight-tube watertube boilers? Why?

A—They are flared. The ends do not come in contact with hot gases, and there is no danger of their burning off.

Q—How is a cross-drum, sinuous-header boiler supported?

A—The front end is supported by sling bolts to the top of front headers, or by U-bolts on the front end of horizontal circulating tubes. The rear end is supported by suspending the drum or resting the ends of the drum on cross beams by cradles or riveted pads.

Q—How many connections are there to the mud-drum of a B&W boiler other than the mud-drum nipples?

A—Usually one or two blow-down connections.

Q—How is access to the various gas passes over the tubes gained?

A—Through clean-out doors in the side wall, except in the standard Heine boiler. Here the baffles are "horizontal" and access is gained through a door on the boiler top on each side of the drum.

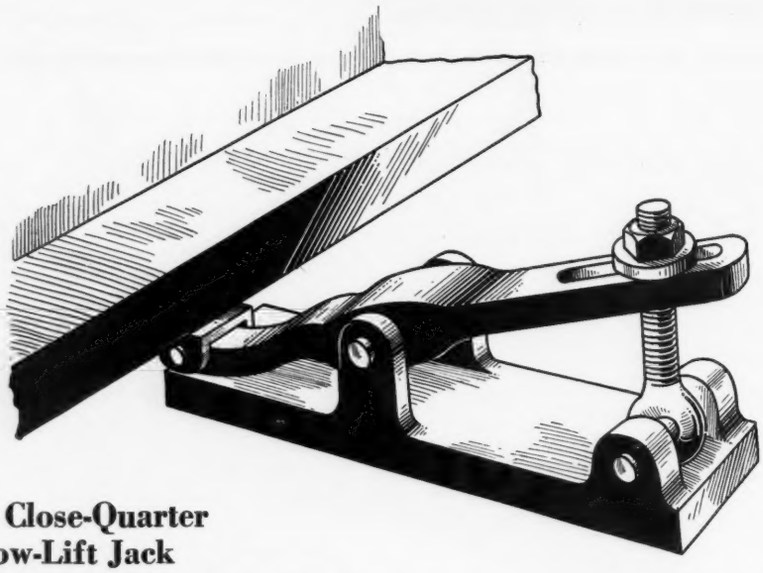
Q—How are water-column connections made in most watertube boilers?

A—To upper and lower parts of one head of the main steam drum.

Q—How many gas passes are there in most watertube boilers?

A—Three.

PRACTICAL AIDS TO OPERATION



A Close-Quarter Low-Lift Jack

THE FIGURE SHOWS a close-quarter jack used to lift in places where ordinary tools cannot be easily applied. It can also be used to separate parts or to force out keys and pins that cannot be driven. This tool is made from either forged or cast steel.

Penacook, N. H. C H WILLEY

Watch Suction Line on Oil Pumps

MUCH OF THE TROUBLE encountered with industrial oil-burning systems occurs in the suction line. This is especially true when No. 6 oil is used. Suction lines are often quite long, and when large-diameter tanks are installed underground, the equivalent suction lift may be high. A slight air leak at a pipe joint will cause a lot of trouble, especially when trying to start up.

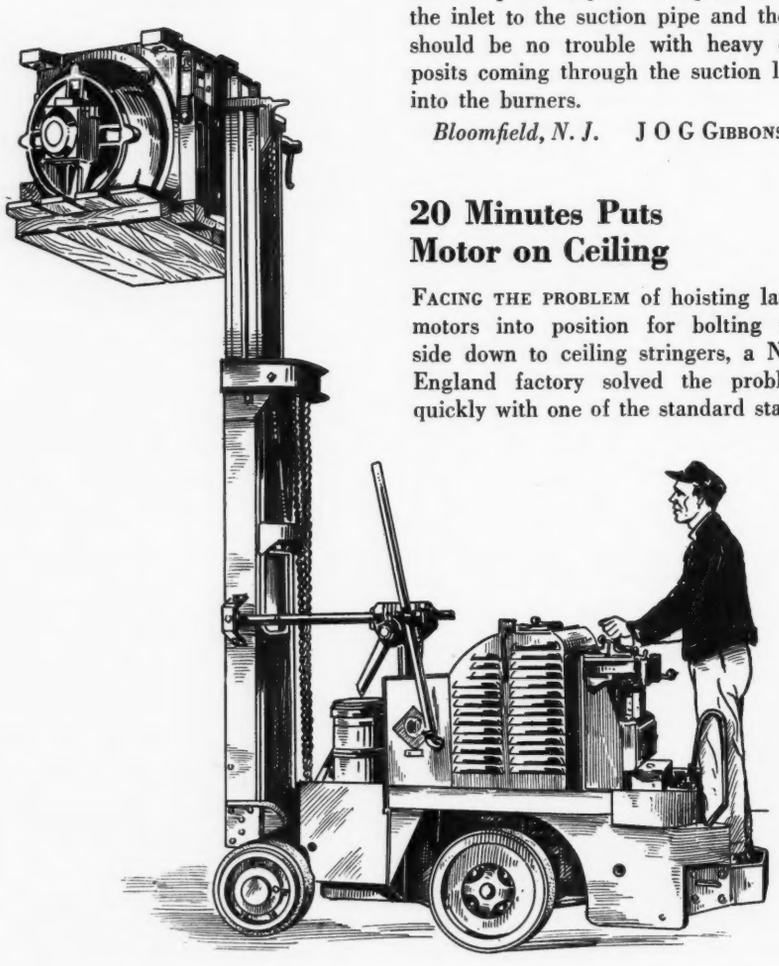
To avoid trouble, keep the suction-pipe resistance to flow as low as possible. It is almost universal practice to use suction strainers with mechanical burners, but I seriously question if this is necessary. It was adopted from marine experience, but conditions on land are different. One burner manufacturer never uses a suction strainer unless requested, and does not have trouble because of not doing so. I do know, however, of trouble being cleared up by removing the suction strainer, thus reducing the resistance to flow in the suction line. Keep the suction line as free from bends and high resistance fittings as possible.

To maintain good suction conditions, do not let oil temperature in the line go much above 100 F. Something depends upon the oil, but temperatures that encourage it to vaporize are likely to cause trouble. If oil in the tank is heated to around 140 F, it will probably cause sludging, and sludge is one of the chief excuses for suction strainers. Avoid high temperatures and you automatically reduce the necessity for cleaning out the tank. It is not only a waste of heat, but bad practice to keep the main body of oil in the tank hot. Keep the required temperature at the inlet to the suction pipe and there should be no trouble with heavy deposits coming through the suction line into the burners.

Bloomfield, N. J. J O G GIBBONS

20 Minutes Puts Motor on Ceiling

FACING THE PROBLEM of hoisting large motors into position for bolting upside down to ceiling stringers, a New England factory solved the problem quickly with one of the standard stack-



ing machines used for handling boxes and bales in warehouse.

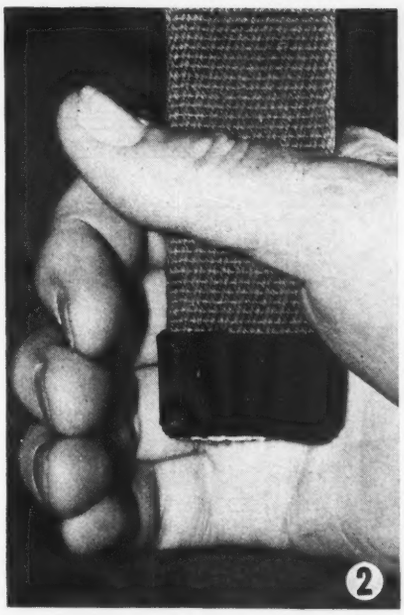
Method is obvious from drawing. First, place bolts head up in stringer holes. Motor, mounted upside down in wood cradle on tierer shelf, is raised within 2 or 3 in. of its final position. Next, move tierer until bolts line perfectly with holes in motor base. Finally, raise platform until motor is solid against stringers. Slip on washers and nuts, tighten nuts, and the job is finished safely, quickly and without heavy labor.—FIELD EDITOR.

More Power to Brass Polish

ROUND BRASS HAND-GRIP RODS, and those used for decoration on engines and other machines, are usually kept bright and clean. It is easy to apply semi-fluid polishes to these parts with a strip of common trunk webbing as in Fig. 1. The tough fabric does not easily absorb polish, but holds it on its surface. When the webbing is seesawed around the rods or tubing, the polish is always in contact with the tubing.

Wind ends of the strap with tape, Fig. 2, to prevent raveling and to provide a good finger grip. Badly tarnished metal can be cleaned quickly by the webbing and polish. A strip about 20-in. long by 1.5-in. wide is a convenient size and is easily cleaned in gasoline.

Clinton, Iowa FRANK BENTLY



Adds Convenience to Forced-Feed Oilers

TO AVOID MESSY FLOORS, burnt hands and loss of oil with forced-feed sight lubricators, we replaced the ⅛-in. drain plug with a small hot-water radiator valve. Where the lubricator cannot be readily drained into a receptacle, you can attach a small rubber hose to the valve and lead this to convenient draining place. We have equipped our lubricators this way and find it promotes cleanliness and adds to convenience of plant operation.

Aurora, Col. E J DUFF

Stopping Turbine Vibration Caused by Piping

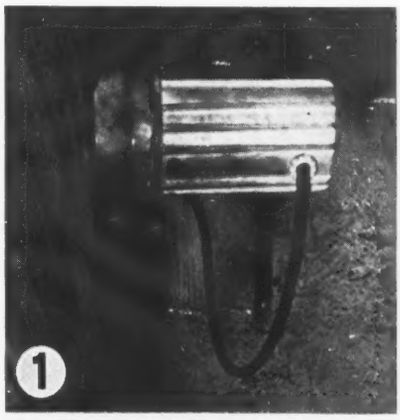
A 2000-KW TURBINE-GENERATOR developed a peculiar case of vibration twice a day, between 9 and 10 a.m. and 2 and 3 p.m. The vibration was severe enough at times to trip the emergency valve. Opening the turbine casing twice showed everything to be in good condition on the inside. Regularity with which the vibration occurred made us suspect that heating and cooling of the turbine parts was causing the trouble. This was found to be true.

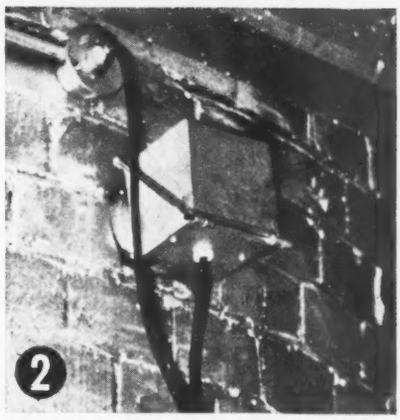
An examination showed that the steam-pipe supports buckled because of expansion and put a twisting action on the turbine-valve casing. Vibration of the turbine gradually worked the pipe through its supports to free the valve casing, when the vibration would stop. When the turbine was shut down at noon and night, contraction of the pipe and turbine pulled the pipe through its supports ready to distort the valve casing when the turbine was started again. Releasing all the anchors on the pipe and supporting it on rollers stopped the vibration entirely.

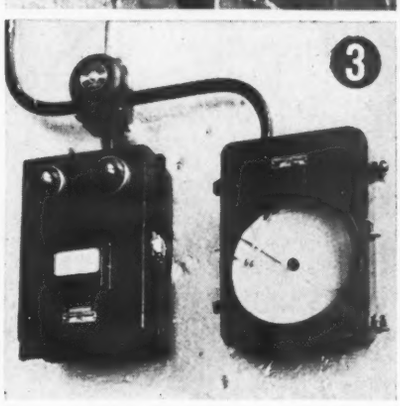
Nagpur, India H C BULSARA

Electric Eye Keeps Watch on Smoke

BRISTOL MYERS CO, Hillside, N. J., keeps its plant spotlessly clean. To reduce the dirt from the power plant as far as possible, fuel was changed







from coal to oil and complete automatic combustion control installed. But oil can cause a lot of smoke if combustion conditions are not correct, so an electric eye in the stack lets the engineer know promptly about this condition.

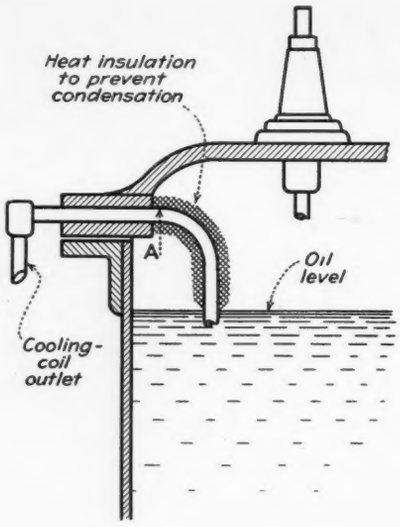
Fig. 1 shows the light source of the smoke detector in one side of the stack and Fig. 2, the photoelectric cell in the stack directly opposite the light source. A relay cabinet and recording instrument, Fig. 3, are mounted on the boiler-room wall near the oil supply and control board.

With smoke on the dark side, the dial pointer moves left of the zero line and a red light shows. When on the light side, the pointer travels to the right of the zero and a yellow light shows. Zero line corresponds with 14% CO_2. The recorder on the right, Fig. 3, gives a 24-hr record of smoke conditions. Since installation of this equipment, it is no longer necessary to go out of the boiler room to check on the smoke.

Philadelphia, Pa. C C HERMANN

Current Leak Eats Hole in Cooling Coil

THE COOLING-WATER COIL in one of our transformers, which had been in operation for 30 years, leaked near the inlet bend, at *A* in the diagram. Since



the radius of the bend was small we thought abrasion by solids in the water had caused the trouble. An examination showed inside of the pipe in good condition, all loss of metal being from the outer wall of the pipe, apparently caused by electric current.

A ground on the direct-current lighting system caused the trouble. This ground produced a small voltage between the transformer-cooling coil and the earth. Cooling-oil heat insulation above oil level had become wet from condensation and made the insulation a fairly good conductor for ground currents between the coil and transformer case.

The photo shows that the action of the current was deeper at *A* nearest the tank. Pitting decreased from this point because resistance to current flow increased the farther we got away from the transformer tank.

We corrected the trouble by grounding the cooling coil and insulating the dc lighting system.

Rio de Janeiro, Brazil
M P COUTO SANTOS
Westinghouse Electric & Mfg Co

Gage Don'ts and Do's

AFTER A PRESSURE OR OTHER GAGE has been calibrated, don't destroy the calibration in installing it. Never tighten a gage onto its connection by twisting on its casing, or you may strain the mechanism in the gage. Use a wrench for all loosening and tightening of connections and apply it so that strain will not be put on the gage parts.

Do not pull on the gage to line it up with the piping. Use a wrench on the pipe fittings. When the gage is installed do not permit piping to put any strain on it. When panel mounted, make sure that the gage fits the panel surface before tightening the holding bolts. Fit all gage covers tightly and clean the glass.

When installed on a steam line, provide a syphon in the gage connection and make sure it is full of water before applying pressure to the gage. Steam temperatures quickly destroy gage calibration. Provide a test connection with valve near the gage so that a test gage can be attached easily. This connection will also be handy for periodically blowing dirt and sediment out of the line and connections to the gage.

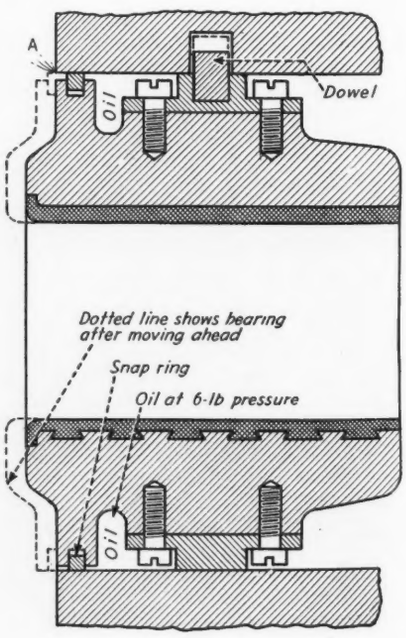
Protect the gage against vibration. Where pressure pulsates, install pulsation damper. Such a device will soon pay for itself in increased service life of the gage.

Roanoke, Va. S H COLEMAN

Bearing Movement Caused Oil Leak

AN UNUSUAL OIL LEAK occurred on the thrust-end main bearing of our 1500-kw steam turbine. The machine had been put into service at 9 a.m. By 1 p.m., oil-reservoir level had fallen to the low mark, a loss of 4 gal. Apparently, the oil was leaking through the oil seal at the rear of the governor housing. The machine had to be run until 4 p.m. before it could be shut down, and during this time we found that the rate of oil leakage increased with the load on the turbine.

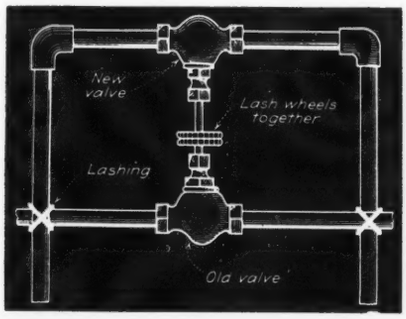
The bearing is held in a housing filled with oil under 5-lb pressure, leakage from the housing being prevented



by a snap ring, shown in the drawing. We found that the dowel holding the bearing in its housing had worked loose and allowed it to move ahead as indicated by the dotted lines. In this position, the snap ring extended far enough beyond the housing to allow oil to leak out. To prevent the dowel pin from working loose again we welded it in place. Since then we've had no more trouble with oil leaks.

Fort Pierce, Fla. T C CHEATHAM

Shutdown Avoided from Broken Valve



THREADS FAILED ON THE STEM of an old globe valve. We could not shut down the line to put in a new one, so solved the problem temporarily as in the figure. With 4 short pieces of pipe and 2 elbows, we connected the new valve so that it could be lashed to the old one and piping as shown. This permitted using the stem of the new valve to drive the old disk onto its seat. It worked until the line could be taken out of service.

Leeds, England H MOORE

High Water Velocity Costs Money

WHEN SELECTING PUMPS, don't forget that high water velocity in pipelines costs money. In one industrial plant the engineer was faced with the problem of supplying 90,000 gal. of water in 8 working hours and 20,000 gal. during the remaining 16 hr each day, from a source that would require 5400 ft of pipe to connect to the storage tank.

As first planned, it was proposed to install a 225-gpm pump, connected by 4-in. pipe to a 45,000-gal. storage tank. This pump would have to operate against a total dynamic head of over 400 ft and required a 40-hp motor.

Further study of the problem led to a proposal to pump more slowly for more hours each day. At is worked out, we installed a 100-gpm pump, used 4-in. pipe, as before, and enlarged the storage tank to 60,000 gal. This cut the dynamic head from 400 ft to about 80 ft, so that a 7.5-hp motor was big enough. Kilowatt hours used for pumping were reduced to about one-half that needed for the larger size pump.

The moral is this: "Keep velocity low in long pump lines if you want to save money—both first cost and operating cost!"

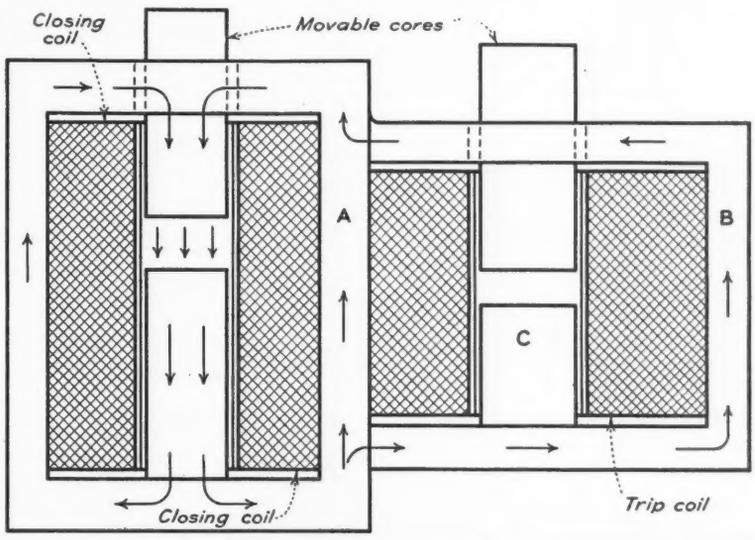
Conchas Dam, N. M.
GEORGE P PEARCE

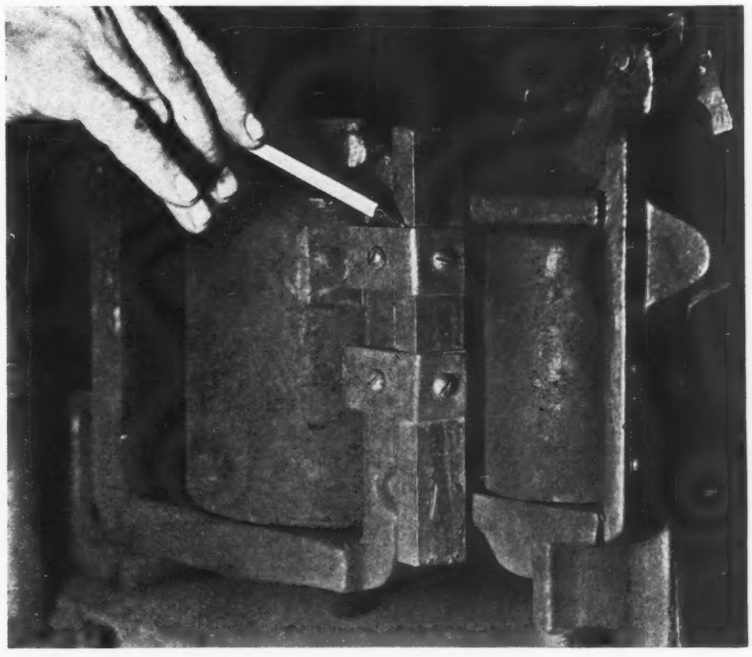
How We Cured a Tripping Oil Switch

WHILE RESTORING A FLOODED POWER PLANT to working condition we found that one of the solenoid-operated oil switches would trip out just as soon as it was closed. On this switch, the closing and trip coils were mounted as in the diagram. When the closing coil is energized, magnetic lines take the paths indicated by the arrows.

Because the closing coil takes a heavy current, we decided that probably frame sections *A* and *B* were saturated with magnetism. This caused sufficient magnetism to pass through core *C* of the trip coil to open the switch. Working on this theory, we fastened two pieces of soft-iron bar to section *A* to shunt magnetic line away from the trip coil frame. The photo shows one of the iron pieces in place. Our theory may appear to be a little wild, but the iron pieces cured the trouble.

Latonia, Ky. DANA GIBSON





READERS' PROBLEMS

Questions for Our Readers

Stop Using Compound?

Question 1

WE HEAT OUR *school system with 4 steel firetube boilers, 3 of which are more than 25 years old. Feedwater is good, with 65 ppm total solids, consisting of chlorides and some calcareous and silicious matter. Boilers show little scale and practicaliy no pitting. We use only enough boiler compound to maintain a positive test with phenolphthalein indicator.*

We are now erecting a high school and doing some remodeling of heating plants in the present buildings. The heating engineer who designed the new plant and who is being consulted in remodeling work has advised discontinuing use of boiler compound entirely. He gives these reasons: (1) unnecessary in low-pressure boiler, (2) does not help in controlling scale and pitting in heating boilers, (3) interferes with proper working of return traps, and (4) causes rapid deterioration of radiator expansion elements and other delicate parts of the equipment.

This advice differs so much from our own rather limited experience and from counsel of others that we would like to get opinions from POWER *readers.*—JBM

Cooling Oily Drips

Question 2

WE HAVE *a number of low-pressure drips, including those from exhaust-steam piping, a closed exhaust-steam feedwater heater, exhaust head and returns from the exhaust-steam heating system which are not suitable for returning to the boilers, as they contain considerable oil. These drips are sources of considerable nuisance and we must provide for better cooling of the hot water before it is discharged to the sewer. How can we dispose of these oily drips to better advantage?*—GAK

SUITABLE answers from readers will be paid for if space is available for publication. Answers accompanied by practical drawings or photographs will command additional pay.

Need More Pressure

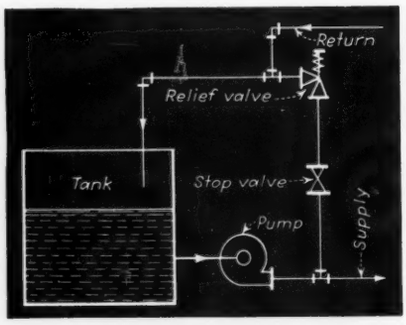
Answers to June Question 1

The Question

IN OUR WORK *we need a constant water pressure of between 24 and 25 lb. We have a centrifugal double-suction pump taking water from a tank at suction level. When direct-connected to a 1000-rpm motor, the unit only produced 19 lb pressure, so we replaced the motor with one turning at 1600-rpm, which brought the pressure higher than we needed. We have tried throttling at the discharge valve, but at times we do not get the quantity we desire. The tank is in such a position that it cannot be raised. What can we do with this equipment to maintain needed 24–25 lb?*—ED

Use Relief Valve

I SUGGEST that ED hook up the discharge line to a relief valve and set this valve to maintain the desired pressure. He can then use the pump and motor he now has. If, though, his trouble is insufficient water at some times, he will have to have a larger pump, larger pipe, or both. The sketch outlines a simple arrangement using a relief valve and stop valve. ED can vary



operation by either opening or closing stop valve. He can then judge the best operating procedure.

Springfield Gardens, N. Y. J C O'BRIEN

Change Impeller

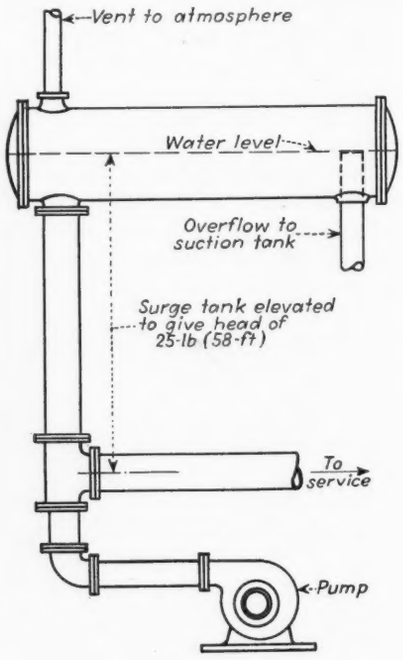
TO GET 24–25 LB with present direct-connected motor (1600 rpm) ED will have to change impeller diameter. Best way to find correct diameter for the conditions is to contact pump builder, giving capacity in gpm required, suction conditions, desired discharge head, motor speed, and water temperature. A characteristic curve of the impeller will show the correct diameter. If impeller, at 1600 rpm, is within range of pumping conditions, it can be reduced in diameter without much, if any, loss of efficiency. In some cases efficiency may increase.

For any impeller, there is a minimum diameter below which undue loss of efficiency results, because impeller vanes lose their function in the proper guiding of liquid through the impeller, causing efficiency loss. The builder knows the minimum diameter for the particular impeller. If, in this case, it would be necessary to cut impeller down below minimum diameter, then the only remedy is reduce speed or buy a new impeller if builder can supply a suitable one.

Seattle, Wash. J Q OSBORNE

Suggests Surge Tank

A SURGE TANK would, I believe, correct ED's trouble more satisfactorily than a relief valve. Tank would need to be above pump at such a height that with tank half full of water, pump would operate against

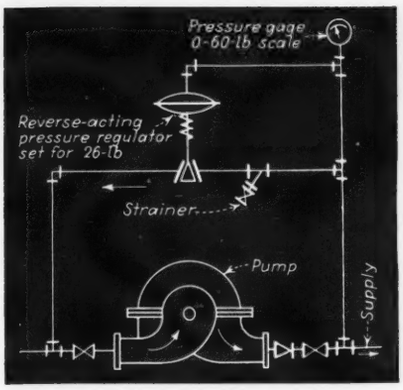


a head of 25 lb. Sketch shows overflow pipe from surge tank to suction tank, to take care of excess water when demand is low. This allows pump to work against desired pressure at all times. Overflow pipe would need to be one size larger than discharge.

Waterbury, Conn. F W CARTER

Regulator Fills the Bill

DISCHARGE PRESSURE required can be maintained by using a reverse-acting pressure-regulator bleeding back to the pump suc-



tion as shown in the sketch. The regulator should be of the double-seated balanced-valve type, actuated with a diaphragm operating against a spring, with provision for hand adjustment of spring tension. A strainer with valve for blowing out, located ahead of the regulator, assures reliable operation.

The diaphragm should be of liberal size, not less than 7-in. in diameter for this pressure. For water service, bronze trim and fabric-inserted rubber diaphragm are recommended. There are a number of these regulators on the market which will give good results if the manufacturer is clearly informed of quantity of water handled by pump, pump discharge pressure at normal motor speed, and desired line pressure.

Vallejo, Calif. T W BEAN

Trouble in Tank

FROM WHAT ED says it looks as if his trouble came from the falling head of water in the tank located at pump suction. Neglecting friction losses, pressure increase from a pump is equal to discharge pressure minus suction pressure; with tank level low, pump will have to provide more pressure increase than with level high, if constant output pressure is to be held.

There are several ways to correct this condition: (1) install a float valve in line feeding tank, so that constant head may be carried on pump suction, (2) replace present discharge pipe with smaller pipe and if pressure varies with suction head install a relief valve, set at desired pressure, allowing valve to bleed back into the tank, and (3) if pump casing permits, replace present impeller with larger one and equip pump with automatic pressure-regulating valve.

Wilmington, Del. F M NEWELL

Really Two Problems

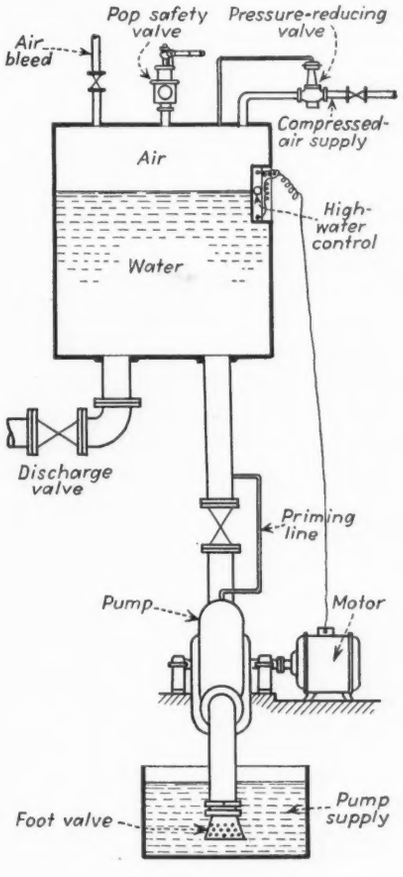
ED ACTUALLY presents two problems: insufficient capacity at peak load and maintaining 24–25 lb at all loads. The first problem is indicated by the statement that flow is sometimes insufficient when throttling at the discharge valve, assuming that 25 lb is being held. This indicates lack of pipe capacity for this pressure at this load, since a "starved pipe" condition wouldn't exist under these circumstances. If rust or other deposits had decreased diameter of present piping, this would decrease discharge, since a 4% decrease in pipe diameter causes a 10% decrease in discharge. Such a build-up would also increase friction head, which would further cut discharge. If pipe is not dirty, and peak loads must be met at 25 lb, then larger pipe is necessary.

Maintaining 24-25 lb at all loads can be easily and accurately accomplished by installing a bypass line from discharge to either pump suction or tank. Amount of water bypassed can be controlled manually or by a diaphragm valve. Manual control is cheaper but requires attention to keep desired pressure. Putting regulating valve in bypass line places no restriction in the discharge. No extra friction head is added to pump, and if 25 lb will deliver necessary amount of water before installation it will do so after.

Wilmington, Del. J. M. TUFFT

Control by Air Pressure

ED'S PROBLEM can be solved by welding a top and diagonal bracing stays on the tank, using a closed tank for water storage. Connect as shown in diagram. By using compressed air reduced to right pressure by a reducing valve to control the tank pressure, water level can fluctuate to take care of variable demand without affecting



pressure at discharge valve from tank. If plant doesn't have compressed-air supply, a small compressor and air bottle will care for the demand. Safety valve assures maintenance of correct pressure as water rises. Air bleed insures continuous operation of pressure-reducing valve and maintenance of correct pressure in the tank.

The float control in the tank makes sure that tank doesn't get too much water, stopping the motor if water rises to maximum level. Pump discharge valve may be left wide open, as air pressure controls pressure on discharge valve to main line. Instead of throttling the pressure on the pump to control flow, the pump will now deliver a larger quantity of water at a head corresponding to 25 lb pressure. Air pressure in tank will have to be determined by calculating pressure produced by static water head on the discharge valve and deducting this from 25 lb.

If the pump is not now fitted with priming connection, it would be advisable to install it. Otherwise pump may lose priming while cut out by high-water float control and damage shroud rings when it starts up again.

Clemson, S. C. J H SAMS

Cut and Try

ED SHOULD dismantle the pump and put shaft and impeller in a lathe to cut down diameter. It is hard to determine just how much to cut down, but I would suggest he take off about ⅛ in., reassemble the pump and try it out. If this doesn't do the trick, successive cuts will.

We had to cut down a 2-stage centrifugal boiler-feed pump to lower the pressure from 350 lb to 225 lb. Cutting down impellers did the trick; the pump now handles about the same amount of water as before and probably could do better, as impeller openings are larger.

ED should be careful, however, not to cut off too much at a time; a cut of ⅛ in. will reduce pressure about 2–5 lb.

Bismarck, N. D. LESLIE BRADLEY

Try Orifice Plate

EVIDENTLY EFFICIENCY of pump and motor is of little importance and the idea seems to be constant pressure. The simplest positive adjustment to give constant pressure would be to insert an orifice plate below the pump discharge valve. Size of hole can be estimated by calculating opening of throttle valve. A couple of trials with valve wide open will show if larger or smaller hole is needed. Plate need only be ⅜-in. thick; hole should be chamfered on entrance side, to minimize turbulence.

Cape Breton, N. S. SAM VINCENT

Change Motor Speed

RULE FOR PUMP SPEED is: speed in fpm of a point on periphery of impeller should equal velocity which water would acquire in falling from same height as total head pumped against. Total head is sum of all friction, velocity and static heads between suction-pipe intake and delivery-pipe outlet. If ED calculates total velocity of total head pumped against he can get the rpm needed to maintain 24–25 lb pressure. Next step is to convert 1600-rpm motor into a variable-speed unit.

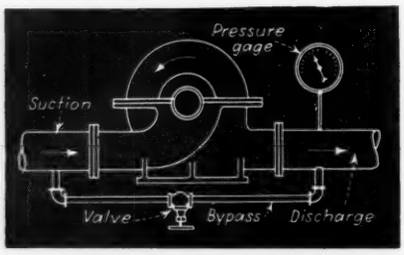
If shunt wound, ED can use field control or armature control. The first consists of a

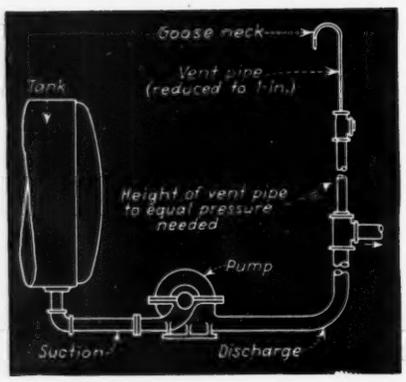
variable resistance connected in series with the shunt-field winding across the constant-voltage main. The field may thus be strengthened or weakened, decreasing or increasing speed. For armature control, insert a resistance between source of emf and armature. Varying this resistance changes armature voltage, altering current and speed.

Brooklyn, N. Y. FRED KOCH

Use Bypass or Vent

THROTTLING DISCHARGE of a centrifugal pump is bad practice. Cheapest way out for ED would be to install a bypass with a valve, or to try a plan adopted in marine





practice, that of carrying an open pipe, to a height corresponding to the pressure required. Sketches show both schemes.

Grand Rapids, Mich. J M GORRIE

How to Figure RPM

APPARENTLY ED's problem is one of impeller speed adjustment rather than throttling of discharge. It is known that pressure head which a centrifugal pump will produce varies as the square of the impeller speed. When ED's pump ran at 1000 rpm it delivered a head of 19 lb or 43.8 ft. Needed head is 25 lb or 57.7 ft. Turning the above rule around, it can be seen that speed varies as the square root of the head delivered. Knowing two heads and one speed it is easy to get the other speed by dividing one head into the other, taking the square root of the answer and multiplying by the original rpm:

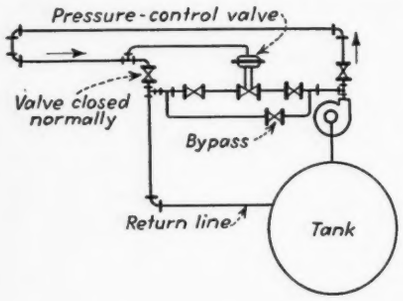
$$\text{RPM} = \sqrt{\frac{57.7}{43.8}} \times 1000 = 1150$$

It should not be difficult to obtain an electric motor rated at 1150 rpm. Inasmuch as the motor on hand operates at 1600 rpm a speed reducer could be used, and if of the variable-speed type, it would have the practical advantage of being adjustable to meet variations in operating conditions. A belt or geared drive could also be used to give needed speed reduction.

Cleveland, Ohio A R CIOTTI

Also Suggests Bypass

ED CAN CURE his trouble by running a line from discharge side of pump back to suction side or, preferably, the tank. With line of sufficient size to handle excess flow, main



pressure can be controlled by an automatic or manual control valve in bypass.

If general piping layout is suitable and expense is not prohibitive, a more satisfactory arrangement could be worked out as shown in the sketch. Pressure in entire main would be controlled by a pressure-regulating valve connected from discharge of pump to extreme end of main.

Moosejaw, Sask., Canada H C YEO

Drain Lines Clog

Answers to June Question 2

The Question

WE HAVE TROUBLE *with the drain lines of our humidifying systems, which become clogged. These drains are from unit humidifiers in our weave room and we have heard of numerous other mills having the same trouble. Some evidence seems to point to algae as the cause, although it may come partly from gelatin used in sizing thread, inasmuch as the mills referred to are all rayon-weaving mills it could not be any kind of lint. In appearance it is a gelantinous mass.*

Assuming that this formation is caused by algae, would the use of copper drain lines be of any help? We suppose that the answer to this might depend on the chemical analysis of the water supply, which is zeolite softened, with a pH between 8 and 9. What are other possible ways of attacking this problem?—GAS

Copper Sulphate Will Help

COPPER SALTS have been used again and again for killing algae. Assuming that the formation is caused by algae, I believe that installation of copper drain lines would help relieve clogging, since some of the copper will be dissolved by the water. However, if an insufficient amount dissolves, clogging may continue.

Before going to the trouble of installing new drain lines, why not add some copper-sulphate crystals to the humidifier water near the point of trouble, enough to maintain a concentration of about 20 ppm. Since copper sulphate is acid, pH value of water should be checked and if below 7.0, enough soda ash should be added to turn a strip of red litmus paper blue.

Another effective chemical for controlling algae is chlorine. This may be purchased conveniently as sodium hypochlorite or calcium hypochlorite or chloramine. Chlorine is also corrosive to equipment. It has been claimed that the dichromate type of corrosion preventative, used in recirculating systems, will also aid in killing algae.

Brooklyn, N. Y. L I PINCUS

Oil May Cause Trouble

ALGAE COMMONLY cause trouble in humidifiers, but GAS refers to the matter clogging the lines as a gelatinous mass. As the humidifier is being used in the weave room, I suggest he make a simple test to see if this matter is not due to oil rather than algae. It may seem improbable that oils used on the yarn and machines are volatile, yet there is a spray or a volatile part given off from some of this equipment. The oily substance collects in the humidifying-system water and in this state, it resembles a gelantinous mass. Collect some of this material and test it with naptha or gasoline. If oily it wi'l dissolve rapidly, leaving only insoluble dust and dirt. If the test works, it may suggest a method of opening the drains—that is, by use of kerosene.

Lakewood, Ohio J P SIMONS

Suggests Chlorine

ALTHOUGH NOT a weaving mill, we have had the same difficulty in a similar device. Admitting that the best approach would be by a chemical analysis, and doubting the formation of algae in water of that pH, let's take the problem as GAS states it.

Using copper drain lines would be of little or no value as algae can form on practically any surface. Algae can be controlled by addition of copper sulphate, potassium permanganate, or by use of chlorine. I believe chlorine introduced into the drain lines would be the best solution to this particular problem. Of course, material used will be determined by effect on the product. Quantity of chlorine used is recommended at one lb per million gal. Of the other chemicals, about 0.5 ppm will be sufficient for nearly all varieties.

Cleveland, Ohio P J SHEPHERD

Need Analysis

THE LOGICAL first step for GAS is to have an analysis made of the material found in the clogged drains. If analysis shows principle trouble is due to algae, it can be removed by use of chemicals available. It is, however, quite unusual to find algae growing other than in places where the water is exposed to bright sunlight such as spray ponds. Assuming that the formation is algae, copper drain lines wouldn't help.

Atlanta, Ga. C T BAKER

ARGUMENT CORNER

Principles Are Old, the Practices New

REGARDING THE LETTER, "Are We Engineers?" page 109, June number of THE OPERATING ENGINEER, I think the attitude of Mr Mackey is wrong, though interesting.

Mr Mackey takes exception to the expression "amperes," used to rate capacity of engine-driven dc generators. I have heard the same expression used many times by engineers in Mackey's own state of New Jersey. It is an old one, and though probably not correct, lots of old timers use such an expression because they assume certain pressures and voltages they have been using for years. I agree that it sounds foolish to the man more used to correct technical terms, but that by no means certifies that the old timer in question is either dumb or foolish.

I will admit that it would be a bewildering experience for such an old

Exchange of Ideas (Duff)

timer to be taken to a power plant and asked to take care of boilers of 1000 lb pressure and turbine-generator sets of 30,000 or 40,000 kw capacity. But in his own field he may be an expert and doing a good job.

The man out on the plains of Texas who runs a diesel plant, with possibly a small steam outfit as standby, may be just as much an expert in his particular field. It is just possible that men of a larger city used to a machine shop and the finest tools might find themselves in hot water in such a place. The same holds true for the Texan if you were to move him to the city.

We all learn as we go along, and it is impossible to stand still and still hold a job. I cite an experience of my own, which will show this more fully. I came out to the Middle West about 1923. Before that, I had worked at about every position (and in many plants) along the Atlantic Seaboard. Along with this, I had been employed by a large boiler firm at positions from tool boy to erection engineer, and with all this experience, I knew a few things.

Imagine then my surprise to find I knew practically nothing about the lignite and bituminous coals of the west. Yes, even the oils were different—the plants out there had to be built accordingly and operated by men who knew the ropes.

We are all human and we all make mistakes, so then next time Mr Mackey goes traveling, let him visit some of those men, with the idea in mind of sitting down to an exchange of ideas. It is just possible that he may come back with something that will help him considerably. After all, you can't gain the merit without the experience, be it in an ice plant, steam heat plant, or any other; yet you go from one to the other and you find you can start in to learn again.

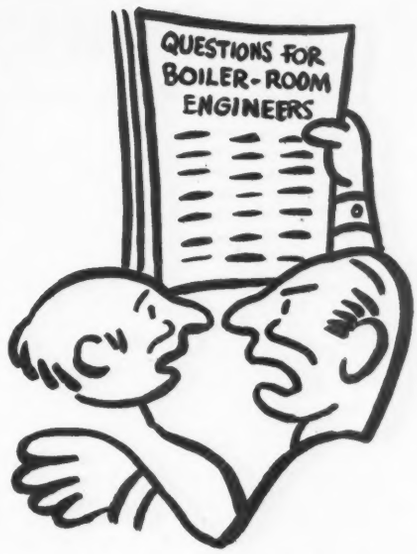
And as to making the examinations harder, I say no! Make them more intelligent by cutting out a lot of useless and tricky questions that are of no use to the engineer or anybody else. Make it so that when the applicant has finished, the examiner can judge if the man in question is fairly well qualified to use his head when it is needed.

The principles are old, the practices in every plant are new.

Aurora, Colo. EDWARD J DUFF

How Would You Do It?

IN CONNECTION WITH answers to "Questions for Boiler-Room Engineers," I think many of the answers are open to further comment but would particularly like to refer back to the question: "How would you determine the proper height for the water column?" The answer given was: "Fill the boiler with water to a level 3 in. above the top row of tubes (usually the rear). Install the water column at a level where water starts to flow from the bottom gage-glass nut".



Might be Trouble (Carter)

If you take 3 in. above the top of the tubes at the lowest end, usually the rear, I am afraid that serious trouble may crop up because much depends on the pitch of the boiler. Par. P-291, ASME Boiler Code, says, ". . . when water is at lowest reading in gage glass, there shall be 3-in. of water over the highest point of the tubes, flues or crown sheet". Many times, unexpectedly, water leaves the glass and with only a small amount over the tubes, there might be trouble, whereas with gage glass set as per Code, hazard is decreased.

It looks like a cumbersome job to go to all the work of filling the boiler with water to get the glass height and a good mechanic would do it with a level, or the usual way water has of finding its own level would show where the water glass should be. If he had to fill the boiler with water, he would experience difficulty unless he plugged off the water connection end of the water column. Were I in charge of a power plant and were that the only way a man wanting a job could arrive at a conclusion, I don't think I'd hire him for he wouldn't have enough foresight or mechanic's ability. Of course if the glass were already installed, one way of checking would be to use Mr Spring's method, but I don't think it would be done on a new installation.

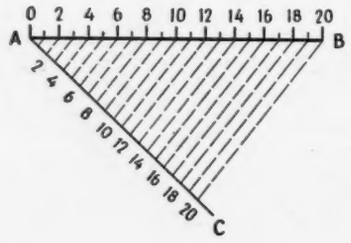
Binghamton, N. Y. C W CARTER JR

More About Areas

by Phil Swain

Headwork Section for July showed how to figure the areas of the common flat shapes: rectangle, square, triangle, circle, ellipse, flat ring and irregular polygon. Here are rules for any irregular shape, whether or not sides are straight

DIVIDING A LINE

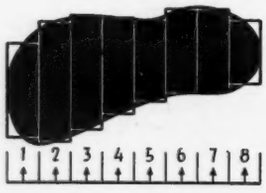


Note: To apply method shown next for irregular areas you must be able to divide a line into any number of equal parts. Method shown here by example.

Ex.: To divide line *AB* into 20 equal parts. First draw line *AC* 30 to 45 degrees down from *AB*. Starting at *A*, lay off 20 equal spaces along *AC*. Spaces may be of any convenient length (as ⅛ in., ¼ in., etc), but better make them so total length of the 20 spaces on *AC* is more than half *AB* and less than double *AB*. Then connect 20 mark on line *AC* with *B*. Through the graduations on line *AC* draw lines parallel with the 20–20 line to cut the scale *AB*. Label as indicated.

IRREGULAR AREA

METHOD I

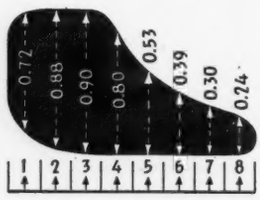


Rule: Divide the length of the area into an even number of parts (more parts will give greater accuracy). Draw rectangles as shown, so that boundary of area cuts top and bottom of each panel at its center. Measure and add the heights of all the rectangles. Multiply this sum by rectangle width to get total area of rectangles. This is the approximate area of the shape.

Note 2: Actual drawing of the panels is not necessary if heights are measured along center lines *1, 2, 3,* etc.

Ex.: Sketch illustrates division of shape into 8 panels. More panels would give greater accuracy.

METHOD II



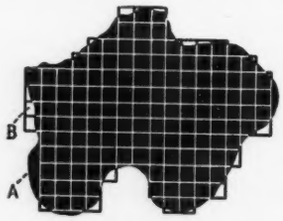
Note: This is a variation of Method I to get average height of an area (as of an indicator card).

Rule: Divide length of area into any number of equal parts. Measure height of area along center of each part. Average these to get average height.

Ex.: Divide length of card into 8 equal parts. Middle height measures 0–72 in. for part 1, 0.88 in. for part 2, and so on as shown. Average of eight measurements is 0.595 in.

Note: To show further application to indicator card, assume this card was taken with a 60-lb spring (meaning steam pressure of 60 lb per sq in. raises pencil 1 inch). Then MEP (mean effective pressure) = 60 × 0.595 = 35.7 lb per sq in.

METHOD III



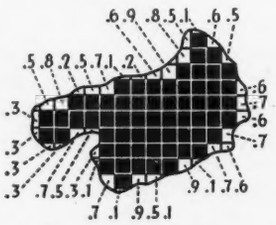
Squares total 142

Note: This method can be used where area is drawn on squared paper or where transparent squared paper can be laid over area.

Rule: Following edges of squares, trace an outline having practically same area as shape to be measured. By eye, balance squares that run over edge against those that run short. Count squares and multiply by area of one square.

Ex.: Full squares here count 142. If squares are 0.1 in. on side, area of each is 0.01 sq in. So area of shape = 0.01 × 142 = 1.42 sq in.

METHOD IV



Squares total 62
Fractions total 17

Note: Method III used full squares only. This works with fractions.

Rule: Following edges of squares, trace an area falling just *inside* shape to be measured. Count the squares so included. Add to this the fractions of squares (estimated), not covered by the area of full squares.

Ex.: Full squares total 62
Fractional squares equiv. to.... 17
Total squares = ... 79

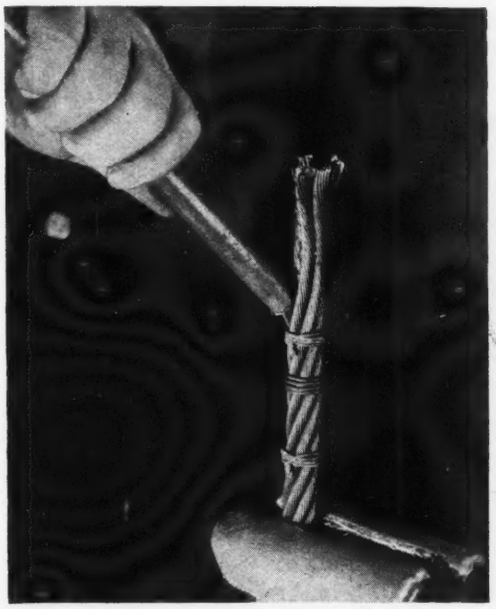
For squares 0.1 in. on side, area of shape = 0.01 × 79 = 0.79 sq in.

METHOD V

Note: Here's a short cut for rough, quick work.

Rule: Block the shape out with a few rectangles (and triangles) to give about the same total area, as judged by eye. Measure the rectangles and triangles, figure their areas, and add.

HOW TO SOCKET WIRE ROPE



←1

Hold rope in vise. At distance from end of rope equal to length of socket basket, seize rope securely with wire. (See page 108, July POWER). Put on two additional seizings. Remove end seizing and separate strands with piece of small pipe

2——→

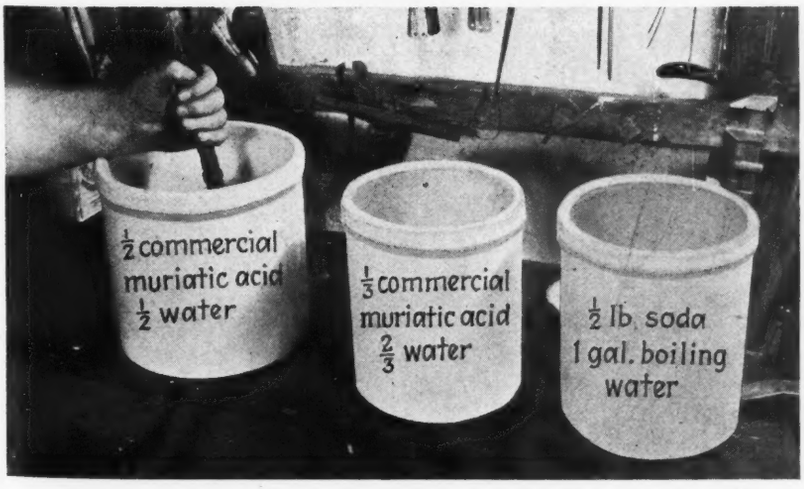
Cut out hemp center, for approximately ¾ length of socket basket, or close to first seizing

←3

Thoroughly clean strands with cloth soaked in gasoline or other grease solvent

4——→

Untwist strands with pliers. Straighten wires, and clean them with a cloth soaked in grease solvent, over the length that will be in the socket



←——5

When wires are clean, dip for a length not greater than ¾ of clean length into a solution of ½ commercial muriatic acid and ½ water for about a minute. Next, dip wires for about one minute into a solution of ⅓ muriatic acid and ⅔ water. Don't let acid come into contact with any other part of the rope. Then dip wires for 2 minutes into a solution of ½ lb of soda in 1 gal. of boiling water to neutralize the acid.

7

Bind end of wires with two turns of seizing wire. Twist ends of binding wire together and pull binding tight with pliers, to bring wires within small diameter of socket basket. Tighten binding wire by twisting. Rope is now ready for socketing

10

Here is a cross-section of properly done job. Spelter adheres to cleaned wires, giving appearance of conglomerate mass of wires and spelter. Use pure spelter, free from dross and just hot enough to scorch a dry, soft pine stick when dipped into spelter and withdrawn quickly. If stick chars, spelter is too hot. If zinc adheres to stick, zinc is not hot enough. 830 F is about correct temperature

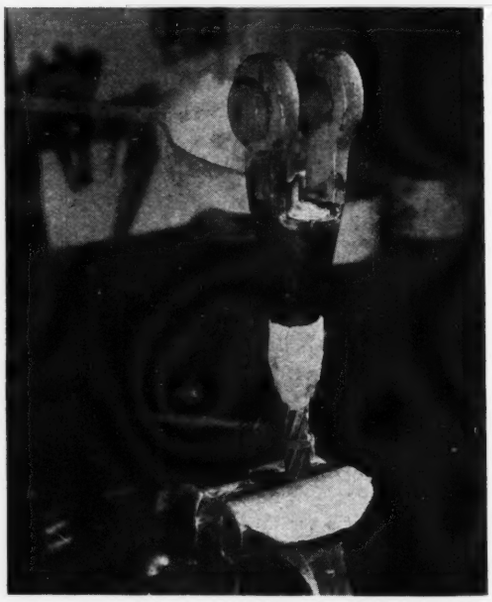
6

When rope is taken from soda solution, shake wires free of all liquid and let them dry while still warm. Wires are now clean and ready for the socket

Photos courtesy of A Leschen & Sons Rope Co

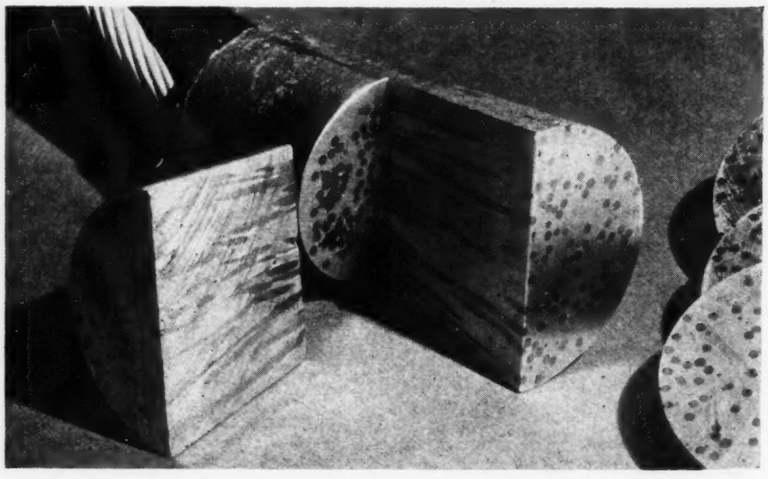
8

Heat socket slightly to assure even flow of spelter when poured. Place socket over end of wires, remove binding and force socket down until ends of wires are level with top of basket. Close bottom of basket with fire clay or asbestos and pour slowly full of pure molten zinc (spelter)



9

Remove fire clay and seizing. Job looks like this if done properly



An Epochal Advance in Motor Control Design

The New C-H Size "O" Motor Control With Dust-Safe VERTICAL Contacts For Motors up to 2 H. P.

Cutler-Hammer announces an important achievement in motor control engineering . . . the New Size "O" Automatic Magnetic Starter for motors up to 2 H. P. This is not Motor Control cut down in size but an entirely new small unit engineered from the ground up to provide the dependable "start-stop-protect" features for which Cutler-Hammer Motor Control is famous. It's *NEW* throughout . . . from air-styled enclosing case to mounting screw . . . from the high-efficiency, long-life contact structure to the exclusive long-life vacuum-impregnated magnet coil . . . from VERTICAL Dust-Safe Contacts to the never-paralleled "Drop of Solder" Eutectic Alloy Overload Relay. For the maximum in starter performance, life, accessibility and trouble-free operation, you'll specify the New C-H Size "O" Starter the next time you buy.

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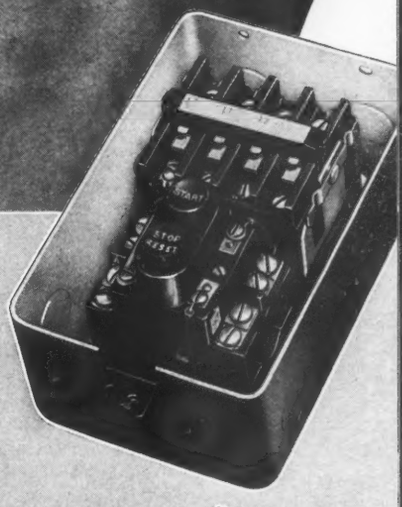


Standard Features of C-H Bulletin 9586, Size "O" Pushbutton Magnetic Motor Control

1. Vertical "dust-safe" twin-break silver-to-silver contacts 99.99% "fine" reduce arcing, prolong life.

2. Vacuum-impregnated, Tung-oil magnet coil, solid, 100% filled for longer life and superior performance.

3. Pivoted construction of magnetic contactor and self-aligning armature eliminates sliding friction, provides equalized contact pressure and quiet operation.

4. Free-tripping, non-closable on overload, tamper-proof Thermal overload protection embodying the famous C-H "Drop of Solder." Overload trip indication. Reset from front of case. Nothing to replace after overload. Relay interchangeable for all h.p.'s by changing heater coils.

5. Mechanism mounted on common base plate, supported on soft rubber bushings. Removed by loosening one screw.

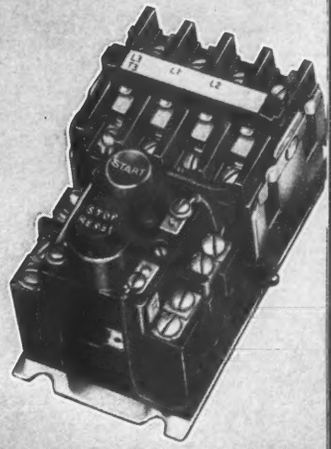
6. Enclosed starter has "light" interior, hook-on cover and provision for padlocking.

7. Open type controllers available for built-in applications.

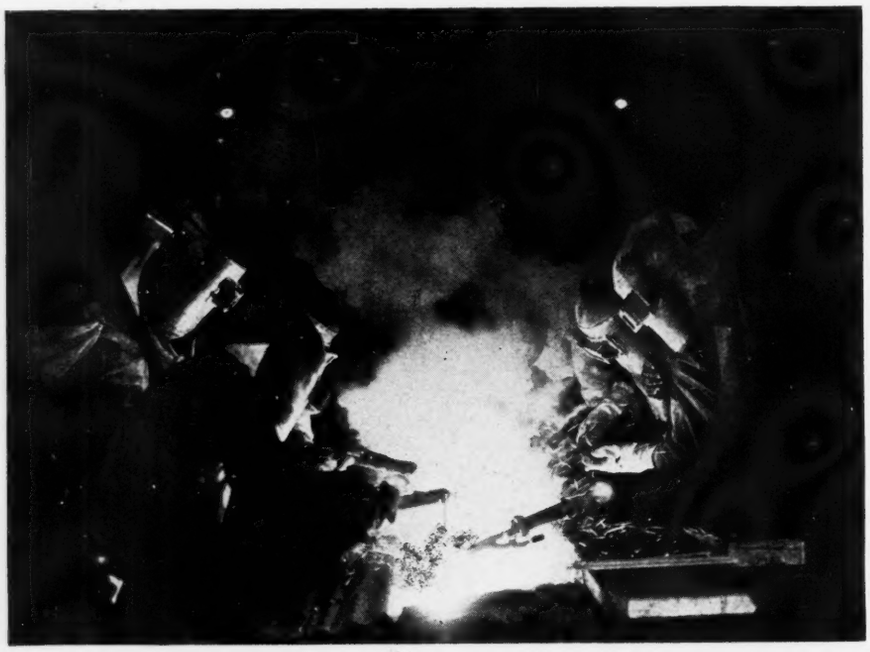
8. Pushbutton operation from front of cover. Other standard forms of control available.

Vertical Contacts Safe from "Demon Dust"

Dust between contacts causes heating and burning. *But dust can't settle on Vertical Contacts!* C-H Contacts are *always* vertical, hence *out* in the open, *air-cooled,* fully accessible.



Engineers' Bookshelf



WITCHES' CAULDRON

When pusher head of a steel-mill scale breaker broke, mill was temporarily removed from service. Arc welders got busy and poured 400 lbs of steel, in the form of arc-welding electrodes supplied by Lincoln Electric Co, into the break. Six welders fixed in 8 hours damage that would have stopped the mill for several weeks

Electricity

INDUSTRIAL ELECTRICITY (1st Edition—1939). *By John M Nadon, Supervisor of Electrical Engineering Instructions; and Bert J Gelmine, Instructor of Industrial Electricity, Apprentice School, Ford Motor Company. Published by D Van Nostrand Company, Inc, 250–4th Ave, New York, N. Y. 607 pages, 5½x8½ in., illustrated, cloth binding. Price $3.00.*

Many books of instruction have been written for practical electrical workers and for those who hope to enter this field. Here is another, somewhat larger and covering more subjects in a single volume than most of its predecessors. It also attempts to give a short and simple mathematical course, something not found in most practical electrical books. To this end, Chapters I and IX, 40 pages, are devoted to Electrical Algebra; and Geometry and Trigonometry.

The book is designed not only for industrial but also for vocational schools. It is also well suited for home study and is the result of many years of teaching courses in elementary electricity in the Apprentice School of the Ford Motor Co.

A wide variety of subjects is included, such as fundamentals of electricity and magnetism, wiring, armature winding, dc generators and motors, dc controllers, fundamentals of alternating current, ac generators and motors, transformers, ac motor controllers, electrical instruments, electron tubes, and electric-welding systems. Not only are the fundamentals treated, but emphasis is also placed on practice by giving considerable attention to methods of connecting up equipment, operating characteristics of machines and industrial applications of motors and controls. The treatment is practical throughout and can be easily understood by anyone with a knowledge of simple arithmetic.

Hydraulics

HANDBOOK OF HYDRAULICS (Third Edition—1939). *By Horace William King, Professor of Hydraulic Engineering, University of Michigan. Published by McGraw-Hill Book Co, 330 West 42nd St, New York, N. Y. 617 pages, 4 x 6½ in., 172 illustrations, 152 tables, semi-flexible binding. Price $4.00.*

The second edition of this book was published in 1929. In this, the third edition, the chief additions are complete revision and extension of the two chapters on open channels. One of these deals with uniform flow and the other with non-uniform flow. These changes have added 94 pages of text and table. In the rest of the book only minor changes and corrections have been made.

This edition, like the earlier one, is divided into eleven chapters: hydraulic units; hydrostatics; orifices, gates and tubes; sharp-crested weirs; weirs not sharp crested; pipes; open channels with uniform flow; open channels with non-uniform flow; measurement of flowing water; natural streams; and tables.

The author still follows his original practice of simplifying calculations whenever possible. By applying a discharge factor to the Manning formula and by using it in connection with appropriate tables it is possible to solve all ordinary problems of uniflow by a simple slide-rule operation. Formulas dealing with critical depth, hydraulic jump, translatory waves, accelerated and retarded flow and gradual transition from one cross section to another are developed and the practical application of these formulas described. The book as now arranged is intended to serve both as a hydraulic engineering handbook and as a text for advanced classes in hydraulics, particularly where it is desirable to place emphasis on open-channel flow.

Steam Engines

A SHORT HISTORY OF THE STEAM ENGINE (1st Edition—1939). *By H W Dickinson. Published by The University Press, Cambridge, England (The Macmillan Co, 60 5th Ave, New York, N. Y.) 250 pages, 10 photos, 65 drawings, 6¼x9¾. Price, $3.50.*

The author, H W Dickinson, is highly regarded in England as the biographer of Watt, Boulton and Trevithick, and in this book has done a very good job for the steam engine.

Heat engines had their beginnings in curious inventions centuries ago, but not until the demand for power became insistent did any practical result arise. Mr Dickinson describes this early history to show at what points and by what men the essential principles were first conceived. He then goes on to the earliest reciprocating steam pumps and then to the development of rotary motion from the piston. After completing the story of the reciprocating engine, the author tells of early attempts to use the kinetic energy of steam, bringing this part to its conclusion in the modern steam turbine.

The best of this book is that it is technical without being obscure—it does tell the reader why and how machines work; and it treats inventors as men, giving a good notion of the vast amount of thought and experiment that has gone into the slow perfecting of these sources of man's power.

Welding

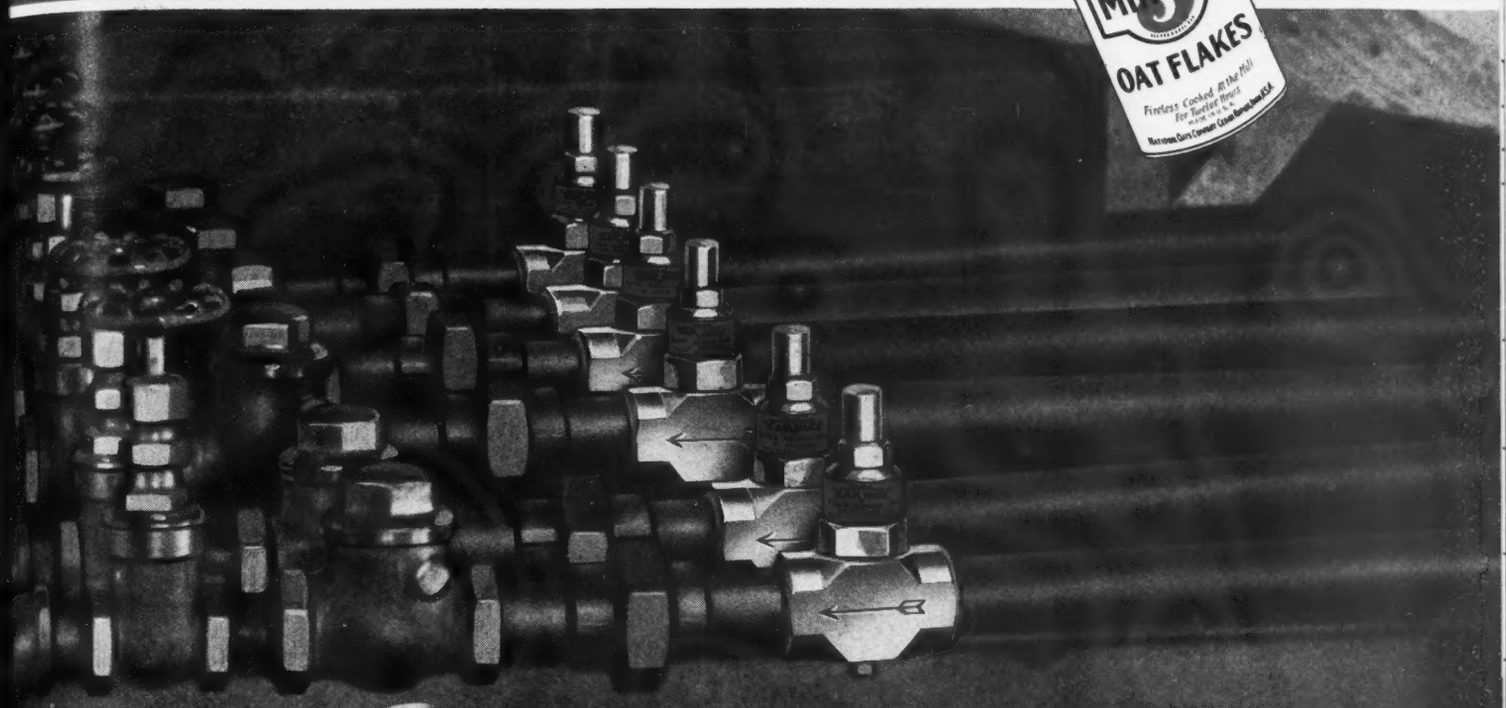
ARC WELDING IN DESIGN, MANUFACTURE AND CONSTRUCTION (1939). *Published by the James F Lincoln Arc Welding Foundation, Cleveland, Ohio. 1408 pages, 6x9 in., 695 illustrations, sketches and drawings. Price in U.S.A. $1.50, elsewhere $2.00.*

One hundred and nine prize papers comprise this book. They cover a wide variety of subject matter, most are presented com-

(*Continued on page* 148)

YARWAY is "The Ideal Steam Trap"

Says the National Oats Company, Cedar Rapids, Iowa



Yarway Impulse Traps installed on a six unit heater in package dryer at National Oats plant. This plant standardizes on Yarways.

"The performance of Yarway Traps in handling condensate from peak loads to practically nothing—plus the fact that they are so easily installed and give us such trouble-free service, make them the ideal trap. Our experience has led us to standardize on Yarways."

(Signed) H. S. WATSON, *Superintendent*
NATIONAL OATS COMPANY

The experience of these famous makers of "Three Minute Oat Flakes" is typical of thousands of enthusiastic Yarway Trap users in almost every branch of Industry.

Have you investigated this trap that gets equipment hotter, sooner—saves fuel—saves space—that is easier and cheaper to install—that costs less to buy than to repair many other type traps?

More than 50,000 Yarway Impulse Traps are already in service and sales are increasing steadily.

Ask your mill supply dealer or write for Bulletin T-1734.

YARNALL-WARING COMPANY
100 Mermaid Ave. Philadelphia

YARWAY IMPULSE STEAM TRAP

Power Lines

Central Illinois Plans New Turbine-Generator Unit

The Central Illinois Light Co is preparing for installation of 35,000-kw turbine-generator in its East Peoria plant, according to the president, R S Wallace. It is expected to be completed in 1941, and will operate at 800 lb, 850 F.

New installation will consist of 25,000-kw, 3600-rpm Allis-Chalmers turbine-generator with Worthington condenser, single pulverized coal-fired Riley steam-generating unit capable of producing 300,000 lb of steam per hr, Foster-Wheeler pulverizers and Peabody burners. The two pulverizers are each capable of handling 32,000 lb of Illinois strip-mine coal per hr. Housed in an extension to original building, the new unit will create no new coal-handling problems, and since the plant is located on Illinois River, no unusual condensing-water problems are expected.

The company recently completed and put into service an additional 25,000-kw turbine-generator unit operating at 400 lb at 750 F.

Heating Exposition Set for Cleveland in 1940

Lakeside Hall, Cleveland, Ohio, will be the scene of 6th International Heating and Ventilating Exposition on January 22-26, 1940. It will be held under the auspices of the A S H & V E in conjunction with their annual meeting. The National Warm Air Heating and Air Conditioning Assn will hold its national meeting during the same week.

J F McIntire, president of the A S H & V E, is chairman of committee in charge, and committee members include Dr. F E Giesecke, W L Fleisher, E H Gurney, M F Blankin, J H Walker, Prof G L Tuve, John P Jones, L T Avery, R M Conner, O W Motz, F H Dewey, J M Frank, W B Henderson, W C Murray, Gardner Poole, Ole Singstad, W J Snow, Ernest Szekely, and E R Taylor. Principal classifications for the exhibits include steam, air and hot-water heating, complete air conditioning, humidification and dehumidification, central heating, unit heating, fans, blowers and ventilating ducts, insulation, instruments, tools and shop equipment, electrical machines and accessories, metals, and materials.

According to the director of the exposition, two-thirds of the space has been sold to exhibitors at the time of writing, and the remainder is expected to be apportioned by the time the exposition opens.

Chemical Industries Exposition Here Dec 4–9

The 17th Exposition of Chemical Industries will be held at Grand Central Palace, New York, December 4 to 9, 1939, with a larger number of new exhibitors than in the past. More than 260 concerns have signified their intention to be represented at the exposition, which will occupy three floors of the Palace in New York.

The Chemical Exposition is this year observing its 25th anniversary of service to the chemical industries. Since it was founded in 1915, there have been 16 previous shows, and the exposition is now established on a biennial basis. Charles F Roth, president of the International Exposition Co, will personally direct the exposition this year, as he has in the past.

GAS-TURBINE PREVIEW

Gas turbines, their construction, use and future, occupy engineers at luncheon given by POWER editors for Dr Adolph Meyer, managing director, Brown Boveri Co, Switzerland. Left to right: C C Franck, Westinghouse Electric & Mfg Co; Francis Hodgkinson, Cons Engr, Westinghouse Electric & Mfg Co; Dr Meyer, E L Robinson, General Electric Co, and George A Orrok, Cons Engr, New York, N. Y.

Fuel Engineers Hear Smoke-Prevention Report

Several hundred fuel engineers, including smoke inspectors, technicians from government bureaus, universities, representatives of the coal industry, and manufacturers of heating equipment heard a report of extensive field study of stokers in actual operation at meeting of the Smoke Prevention Assn held June 14 at Milwaukee, Wis.

The study was made in Columbus, St. Louis, Cincinnati and Chicago by research engineers of Battelle Memorial Institute. Sponsors were the Stoker Manufacturers' Assn, Steel Heating Boiler Institute, and National Coal Assn.

Coal fired by stokers, according to the report, is likely to cause smoke only when manual attention is given the fire or when stoker shuts off. Elimination of tendency for stokers to smoke when shutting down to await the renewed demand for heat was pointed out as a challenge to stoker manufacturers. Ralph A Sherman, supervising fuel engineer at the Institute, and co-author of the report, recommended further research in that field, and said that many more conditions would be studied.

Braintree Adds Turbine

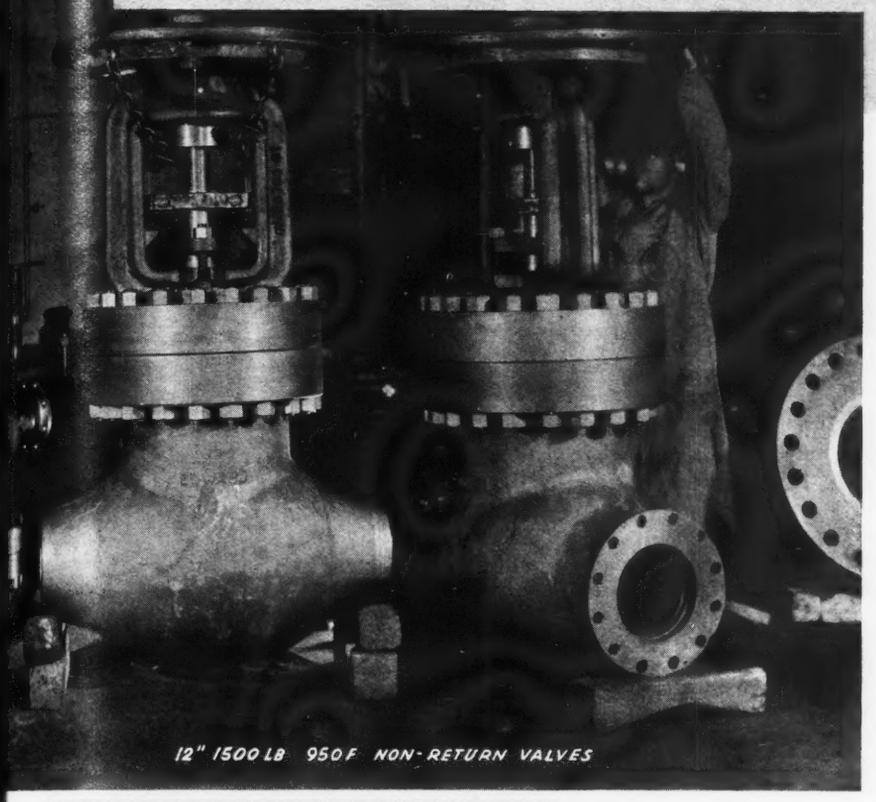
Municipal light dept of Braintree, Mass., has ordered 7500-kw turbine-generator from General Electric Co for delivery May 1, 1940. This additional unit practically doubles capacity of its tidewater plant near Weymouth Landing. Turbine will run at 3600 rpm, 425 lb at 175-F supht. Generator will operate at 13,800 volts. Boiler of about 110,000 lb capacity was installed about a year ago and a condenser for the new unit will be purchased shortly.

American Engineer Designs Gas Turbine

A development similar to those of Allis-Chalmers in the U. S. and Brown Boveri in Switzerland, in the construction of the gas or combustion turbine, has been going on in this country. William E Trumpler, Easton, Pa., has designed an American

Choosing Materials for Edward Valves - No. 10 of a Series

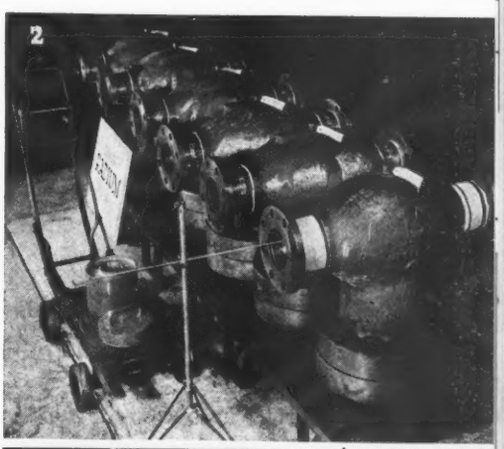
ETERNAL VIGILANCE IS THE PRICE PAID FOR GOOD VALVE CASTINGS



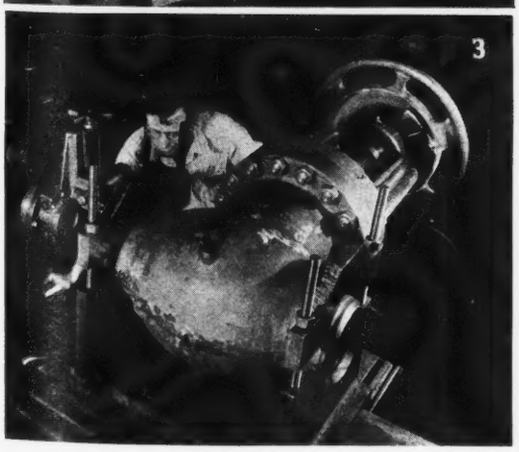
12" 1500 LB 950 F NON-RETURN VALVES

NO formula assures the kind of steel castings needed for high pressures and temperatures. There are too many variables to permit blind adherence to a single technique. Each pattern presents a problem of its own. The human element also may send results haywire. Eternal vigilance is the task of the Edward technical staff which has dealt for years with the most severe working conditions known. There is a knack to detecting sub par castings, in which Edward testers excel. Uncertainty is minimized when buying Edward.

1 SHRINKAGE problems related to molten steel make production of true-to-dimension castings an intricate matter. Photo shows steel castings undergoing dimensional and visual inspection. Magnetic tests are also made to detect minute surface flaws.



2 GAMMA RAY technique helps find possible hidden discontinuities. These check valves are to be provided with welding ends. Temporary test flanges, located well outside finished end to end dimensions, permit thorough hydrostatic test. Two radium capsules are being used simultaneously, one at each end. A typical Edward application of research to production.



3 WELDING ENDS with various V or U grooves are specified by engineers for cast steel valves. In the case of the valve illustrated, from which test flanges are being removed after pressure tests, tapered backing ring is to be employed in field welding.

4 DESTRUCTIVE test of Edward steel castings is afforded by sectioning and deep etching the temporary test flanges. If, after subjection to hot acid, porous areas appear in test flanges desirability of radiographic examination of adjacent portion of casting is indicated. Pieces are saved for micrographic, physical and chemical analysis. Cut shows metallurgist examining test flanges for 4", 6" and 8" 900 lb valves.

THE EDWARD VALVE & MANUFACTURING CO., INC. EAST CHICAGO, INDIANA

EDWARD VALVES

Stop · Check · Blow-off · Non-return · Feed Line · Relief · Bleeder Line · etc.

combustion engine (See POWER, Sept 1935) expected to go on trial operation soon. This turbine will be rated 50 hp and operate at 20,000 rpm. Construction of the trial model was begun in January of this year by Mr Trumpler.

File Application For New Hydro Project

The Orangeburg-Aiken Hydro-Electric Commission, Orangeburg, S. C. has filed application with the Federal Power Commission for a power project on the Edisto River, S. C. The project is to consist of a dam and hydroelectric power plant on the Edisto River just above Cattle Creek; a steam power plant at Graniteville, S. C. and a transmission line extending from hydro plant to steam plant and then to North Augusta, S. C.

The dam will consist of two rolled-fill sections separated by a concrete section, 550 ft long, containing the spillway and intake works. It will have a total length of 16,500 ft and maximum height of 50 ft.

Hydro-electric plant will contain three 4023-hp units, each designed for a normal operating head of 32 ft, and the steam plant will have one unit of 4023 hp, making total installed hp of the entire project 16,092.

Jenkins Valve Contest Winners Are Announced

Winners in the Jenkins Valve Co "Veteran Valve" contest were announced recently by the judges, after consideration of the information sent in by over 1000 distributors' salesmen from seven areas throughout the country. The winners and the areas and companies represented are: William G Archer, Atlanta, Fulton Supply Co; Malcolm Curry, Boston, Curry Bros Oil Co; Allen Straub, Louisville, Louisville Mill Supply Co; John M Holland, Denver, Hendrie & Bolthoff; B Cushman, Rochester, N. Y., Barr & Greelman; F Greaner, Richmond, Va., James McGraw, Inc; and William Freitag, New York, N. Y., Bernard-Greenwood Co.

Each of the winners, with the exception of the metropolitan New York winner, was given a trip, for two persons, to New York and the World's Fair, by airplane, together with side trips, sightseeing, etc. The New York City winner was given a cruise to Montreal, Quebec, and Nova Scotia.

The contest called for a search by distributors and salesmen for the outstanding "veteran" Jenkins valve installation from the standpoint of length and severity of service, and cost of maintenance. Judges in the contest were Jim Channon, manager, Mill Supplies magazine; Harvey Conover, publisher, Mill & Factory magazine; T J Moffett, editor, Plumbing and Heating Journal; and Phil Swain, editor of POWER.

Meetings

American Society of Heating and Ventilating Engineers——*Annual meeting in conjunction with 6th International Heating & Ventilating Exposition, Jan 22–26, 1940, Lakeside Hall, Cleveland, Ohio. A V Hutchinson, secretary, 51 Madison Ave, New York, N. Y.*

American Society of Mechanical Engineers——*Fall Meeting, September 4–8, New York, N. Y. C E Davies, secretary, 29 W 39th St, New York, N. Y.*

ASME Fuels Div, and AIME Coal Div——*Joint meeting, October 5–7, Columbus, Ohio.*

Master Boiler Makers Association——*Annual Meeting, October 16, Sherman Hotel, Chicago, Ill. Exhibit in conjunction with meeting. A F Stegemeier, secretary, 29 Parkwood St, Albany, N. Y.*

National Association of Power Engineers——*Annual Meeting, August 28–Sept 1, Claypool and Lincoln Hotels, Indianapolis, Ind. Exhibit in conjunction with meeting. Fred Raven, secretary, 176 West Adams St, Chicago, Ill.*

Universal Craftsman Council of Engineers——*Annual Meeting, August 1–3, Providence, R. I. Exhibit with meeting. T H Jones, secretary, 4034 N 21st St Arlington, Va.*

JUDGMENT DAY

Judges in Jenkins Valve Co "Veteran Valve" contest. Left to right: Jim Channon, manager, Mill Supplies magazine; Harvey Conover, Mill & Factory magazine; T J Moffett, editor, Plumbing and Heating Journal; and Phil Swain, editor of POWER

Wisconsin Power Co Wins Charles A Coffin Medal

Wisconsin Electric Power Co has been announced as winner of the Charles A Coffin Medal for 1938 for its outstanding contributions to the public and to the power and electric industry during the year. Presentation of the medal was made by H P Liversidge at the annual meeting of the Edison Electric Institute. Accompanying the medal was a check for $1000 to be given to the employees' welfare fund.

Judges for the award were A C Marshall, vice-president, Detroit Edison Co, member of the board of trustees of Edison Institute; Dr Karl T Compton, president, Massachusetts Institute of Technology; and H P Liversidge, president of the Philadelphia Electric Co.

The Charles A Coffin Foundation was established by the General Electric Co in 1922 in honor of the founder and first president. Each year it presents a gold medal and $1000 to the company which makes the most distinguished contribution to development of electric light and power for the convenience of public and industry.

"Liquid Coal" Demonstrated

Dr Francis Godwin, of the Research Foundation Staff of the Armour Institute of Technology, and one of the two men to perfect high-speed photography equipment, was credited with another development in research when he demonstrated an 8-cylinder car operated on "Liquid-Coal", without any change in the ignition or carburetion system.

"Liquid Coal", known as colloidal fuel to research engineers, consists of specially ground coal, as small as 500 mesh, in suspension in a light or other type oil. In the test, it was introduced via an auxiliary tank, after the motor had been started with gasoline.

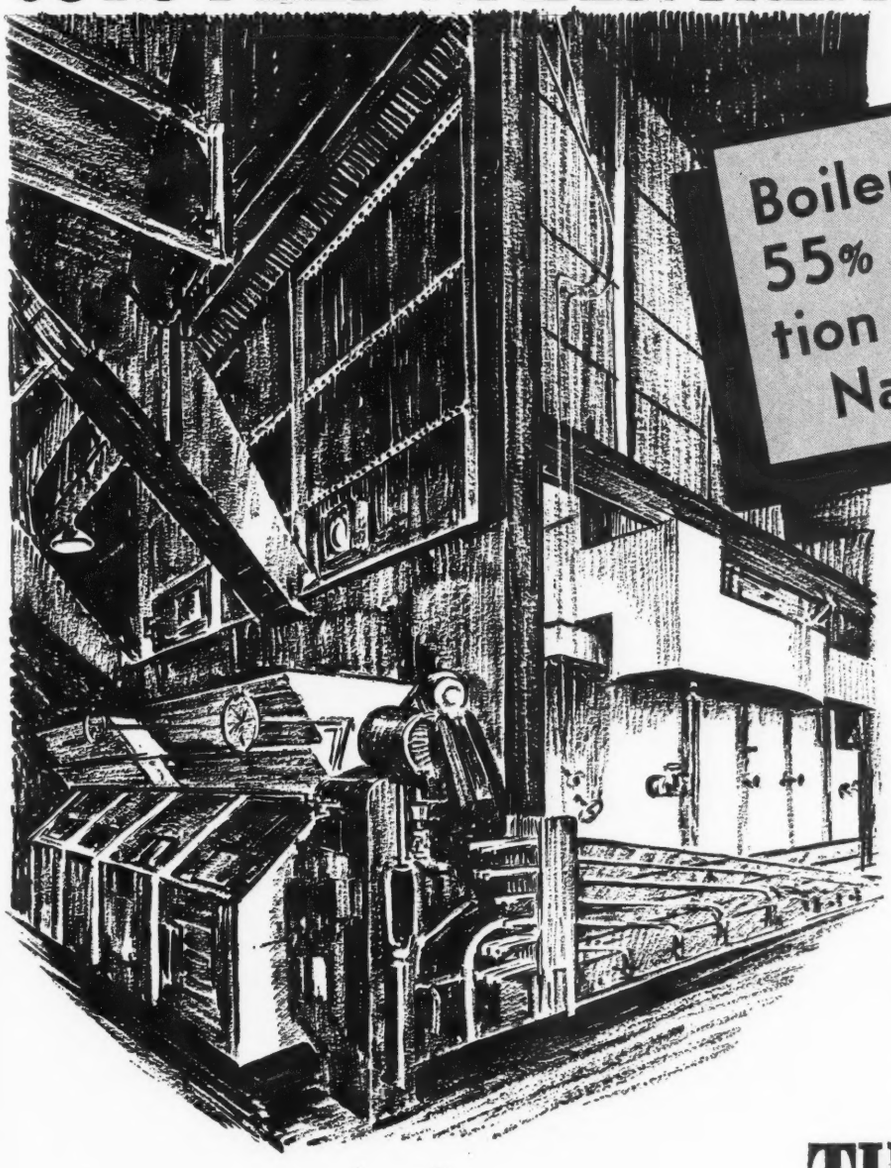
The engineers in charge of the research estimate that they have about one more year on the project before anything will be announced to the general public, or the product put on the market.

Dudley Honored At University of Michigan

A M Dudley, engineering representative, Patent Dept, Westinghouse Electric & Mfg Co, was awarded honorary degree of Doctor of Engineering at the commencement exercises of the University of Michigan, Ann Arbor, Mich. Mr Dudley is a veteran of 35 years service with the company. As an author he has to his credit two books on induction motors, and the Encyclopedia Britannica article on electric motors. He also edited the biography of Benjamin G Lamme. As a professional engineer he has been employed on the design of alternating-current motors, starting, lighting, and ignition for automobile engines, and marine application work.

He served for three years on National Council of the Society for the Promotion of Engineering Education, and has also

CUTS FEEDWATER TREATING COSTS



Boiler Plant Gets 55% Cost Reduction by using the Nalco System

PRIOR to introduction of the Nalco System, a medium size plant in the northwestern part of the country was spending an average of $2628.00 every 365 days for chemicals to treat fairly soft water. This, probably, would never have caused any comment if the results had been satisfactory. Therefore, when the Nalco System eliminated complaint, it was doubly satisfying to find its cost averaging only $1168.00 for a year of 365 days—a saving of 55%.

When one of the boilers in this plant was opened up recently, the engineer reported it: "Cleaner than when new!"

AS every engineer knows, cost of chemicals is a secondary matter as compared with the results secured when it comes to treating boiler feedwater. Nevertheless, it is significant to know that the complete cost of using the Nalco System is seldom more and is often less than for treating methods previously used. Let us make a survey of your requirements. No obligation. NATIONAL ALUMINATE CORPORATION, 6222 W. 66th Place, Chicago, Ill.

THE NALCO SYSTEM OF FEEDWATER TREATMENT

Inquiries other than domestic, *except those from U. S. Possessions, Canada and Mexico,* should be addressed to ALFLOC LTD., Bush House, Aldwych, London, W. C. 2, Eng. Canadian inquiries should be sent to ALUMINATE CHEMICALS LTD., 372 Bay St., Toronto, Ont.

assisted the Engineers' Council for Professional Development on a nation-wide inspection of the work of engineering schools and colleges.

F Malcolm Farmer New A I E E President

F Malcolm Farmer, vice-president and chief engineer, Electrical Testing Laboratories, New York, N. Y. was elected president of the A I E E for the year beginning August 1, 1939. Elections were held at the annual summer and Pacific Coast convention of the Institute. C T Sinclair, Pittsburgh, Pa.; E E George, Chattanooga, Tenn.; Albert L Turner, Omaha, Neb.; H W Hitchcock, Los Angeles, Calif.; J M Thomson, Toronto, Ont.; were elected vice-presidents. Mark Eldredge, Memphis, Tenn.; R E Hellmund, East Pittsburgh, Pa.; and Frank J Meyer, Oklahoma City, Okla., were chosen directors, and National Treasurer W I Slichter, New York, N. Y. was re-elected.

Annual report of board of directors, presented at the meeting, showed a total membership on April 30, 1939, of 16,605. In addition to three national conventions and three district meetings, 1825 meetings were held during the year by the local organizations of the Institute, in principal cities and educational institutions of the United States, Canada, and Mexico.

A S M E Nominates Officers

Nominations for officers of the American Society of Mechanical Engineers were announced at a recent meeting of the national nominating committee held at State College, Pa. Elections will be held by letter ballot of the entire membership, closing on September 26th, 1939. The nominees are as follows:

President—Warren H McBryde, San Francisco, Calif.; Vice-Presidents—Kenneth H Condit, National Industrial Conference Board, New York, N. Y.; Francis Hodgkinson, New York, N. Y.; J C Hunsaker, Mass. Inst. of Technology, Cambridge, Mass.; K M Irwin, Philadelphia Electric Co, Philadelphia, Pa.; Managers —J W Eshelman, Eshelman & Potter, Birmingham, Ala.; Linn Helander, Kansas State College, Manhattan, Kansas; G T Shoemaker, The United Light & Power Service Co, Chicago, Ill.

OBITUARIES

A J Schroth, Empire Mine and Mill Supply Co, Pittsburgh representative of Goetze Gasket & Packing Co, died recently. He had been associated with Goetze for over 30 years.

Harold E Whitney, 55, director of electric power companies within the New England Power Assn, died June 10, Brattleboro, Vt.

Victor Hodge, chief accountant, Wolfboro, N. H. electric power plant, died recently following a surgical operation.

(*Continued on page 150*)

NEW PLANT CONSTRUCTION

McGraw-Hill Business News Department Is Prepared to Furnish a More Complete Daily Service

Arkansas—Arkansas Power & Light Co., H. C. Couch, pres., Pine Bluff, Mo., will award contracts about Sept. 1, constructing hydroelectric dam, about 175 ft. high, across upper Ouachita River at Blakely Mount, about 14 mi. north of Hot Springs. $6,000,000-$8,000,000.

Ark. Highland—American Fruit Growers Inc., J. Cooley mgr., plans constructing 1 story peach packing plant, two 1 story units for oil emulsion plant for production wet spray, and lime and sulphur unit for manufacture of dry spray, etc. $100,000.

Calif., Avon and Martinez—Pacific Gas & Electric Co., 245 Market St., San Francisco, taking bids constructing superstructures for steam plants at Avon and Martinez. Over $150,000.

Calif., Martinez—Shell Oil Co., Shell Bldg., San Francisco, plans expending $650,000 improving refinery in distillation unit No. 4, new gasoline stabilizer and reconditioning alcohol plant.

Conn., Bridgeport — Bridgeport Housing Auth., Rev. S. J. Panik, chn., plans by H. G. Linsay and J. G. Phelan. L. Asheim and F. C. Johnson, associates, Court Exchange Bldg., brick, steel apartment housing building, incl. power plant and recreation building facilities. $6,500,000. Funds allotted. USHA.

Conn., Centerville — United Illuminating Co., 1115 Broad St., Bridgeport, plans by R. W. Foote, 157 Church St., New Haven, constructing 1 story, 40x55 ft., rein.-con. steel power substation and equipment. $40,000.

Conn., New London—Public Works Officer, Navy Dpt., Submarine Base, will receive bids in about 5 weeks, constructing 60x100 ft. power substation. Est. over $40,000.

Fla., Keystone Heights—Clay Co. Electric Cooperative Assn., Inc., C. S. James, supt., plans constructing generating plant addition. $38,000 REA allot.

Ill., Chicago—A. Epstein, archt. and engr., 2001 W. Pershing Rd., taking bids constructing 3 story, basement, 118x173 ft. factory and warehouse, 45th St. and Tripp Ave., for Rival Packing Co., 371 S. Halsted St. $350,000.

Ind., Columbia City—Bd. P. Wks., J. A. Brown, chn., plans constructing power and light plant improvements, 2,500 kw. turbogenerator. $120,000.

Ind., Logansport—E. M. Hoyt, clk., Bd. P. Wks., making plans constructing power plant improvements., rein.-con. generator foundations, piping, pumps, etc. $50,000. C. Ammerman, 772 Century Bldg., Indianapolis, consult. engr.

Ia., Montezuma—Bids Aug. 2, by City, constructing light and power plant system, plant building, 3 generating units, auxiliaries, switchboard and power wiring distribution system. $136,000. A. S. Harrington, Baum Bldg., Omaha, Neb., engr.

Ia., Preston—Bids Aug. 1, by City, constructing light and power generating plant, incl. generating unit and auxiliaries, cooling system, plant building, switchgear equipment. $45,000. R. W. Gearhart, Cedar Rapids, engr.

Ia., Woodbine—Bids July 24, by City, constructing light and power plant, distribution system, 3 diesel generating units, switchboards. $115,000. A. S. Harrington, Baum Bldg., Omaha, Neb., engr.

Kan., McPherson—Bids about Sept. 1, by City, L. C. Angevine, supt. Utilities, City Hall, constructing expansions and improvements to electric power plant, installing new turbine generator unit and accessories, condenser switchgear, auxiliary equipment. $125,000. Burns & McDonnell Eng. Co., 107 W. Linwood Blvd., Kansas City, Mo., engrs.

Minn., Minneapolis — Cooperative being formed (H. Edmunds, Cedar, correspondent) plans constructing cooperative generating plant, Hennepin Co. $500,000 REA allotment.

N. H., Raymond—A. S. Welch chn. Town Bd. Selectmen, Town Hall, plans by H. H. Petzold, 301 Essex St., Lawrence, Mass., constructing 2 story, basement, brick shoe factory, concrete foundation. $118,000. Maturity indefinite.

N. Y., New York—National Gypsum Co., 190 Delaware Ave., Buffalo, plans constructing plant addition, East 148 St and East River. $500,000-$1,000,000. D. F. Hunt, ch. engr.

O., Bryan—Village soon takes bids furnishing 3,000 hp. diesel unit to produce 2,000 kw. and install in power plant. $150,000.

O., Mansfield—Tappan Stove Co., 150 Wayne St., plans by C. Coklin, 303 Farmers Bank Bldg., constructing enameling plant. $100,000.

O., Worthington—Harris Mineral Wells, Inc., 7946 North High St., plans constructing bottling plant and office building. $100,000. D. A. Carmichael, 5 E. Long St., Columbus, archt.

S. D., Vermillion—University of South Dakota, plans constructing power plant improvements, including boilers, pumps, building addition. $50,000. W. J. Dixon, Mitchell, archt. D. W. Loucke, Pierre, state engr.

S. D., Volga—City voted $40,000 bonds, constructing power plant and equipment. H. R. Olson, city electrical engr.

Tex., Brownsville — Woburn Industries, Brownsville, Tex., and Harrison, N. J., plans constructing manufacturing plant. $165,000.

Tex., Houston—Alexson Mfg. Co., Los Angeles, Calif., plans constructing oil well pumping equipment manufacturing plant. $250,000.

Tex., Houston—Champion Paper and Fibre Co., Enquirer Bldg., Cincinnati, plans constructing finishing mill on 160 acre tract. $3,000,000. H. K. Ferguson, Houston, Tex., and Hanna Bldg., Cleveland, O., archt.

Tex., Houston—Gulf Tex Drug Co., Inc., c/o R. Oury, mgr., McKinney and Sampson Sts., plans constructing winery, office, warehouse. $100,000. Architect not appointed.

Tex., Longview—O. H. Grissom & Assoc., plans constructing iron ore reduction plant, using natural gas process. $160,000.

Tex., Texarkana—Town plans constructing municipal electric power plant and distribution system. $250,000.

Tex., Weatherford—Bids about Aug. 1, by C. F. Russell, mayor, 2,000 hp. diesel engines and generators, switchboard, power building, electric distribution system and street lighting. $250,000. A. C. Moore & Co., Smith Young Tower, San Antonio, engrs.

W. Va., Charleston—Union Carbon & Carbide Co., 30 East 42 St., New York City, plans constructing plant addition. $1,000,000.

Wis., Boscobel—Tri State Power Electric Cooperative soon lets contract steam power generating plant, building and equipment, etc. $625,000. A. Y. Taylor & Co., 2 S. Central Ave., Clayton, St. Louis, Mo., engrs.

B. C., Alford Bay—Dominion Governmeent, Ottawa, Ont., making plans constructing light and power plant. $50,000. Dpt. National Defense, Ottawa, Ont., engrs.

B. C., Vancouver—Van Kraft Corp., Ltd., 510 Hastings St. W., plans constructing pulp and paper plant. $150,000. Maturity autumn.

B. C., Vancouver—Yale Saw Mills, Ltd., 718 Granville St., making plans constructing saw and allied mills. $100,000.

Newfoundland, St. Johns — Newfoundland Light & Power Co., Ltd., St. Johns, making plans constructing power development at Mobile Village. $250,000. Private plans.

North West Territory, Fort Norman—Imperial Oil, Ltd., Sarnia, Ont., plans increasing refinery and storage capacity. $150,000. Private plans.

Ont., Toronto—Bat's Import & Export Co., 80 King St., W. T. Bata, pres., plans constructing shoe manufacturing plant. $100,000. Architect not appointed.

Quebec—Provincial Govt., Montreal, preparing plans constructing power plant development, Victoria Lake, Temiskaming Co. $750,000. Running Streams Comn., 7 Notre Dame St. E., Montreal, engrs.

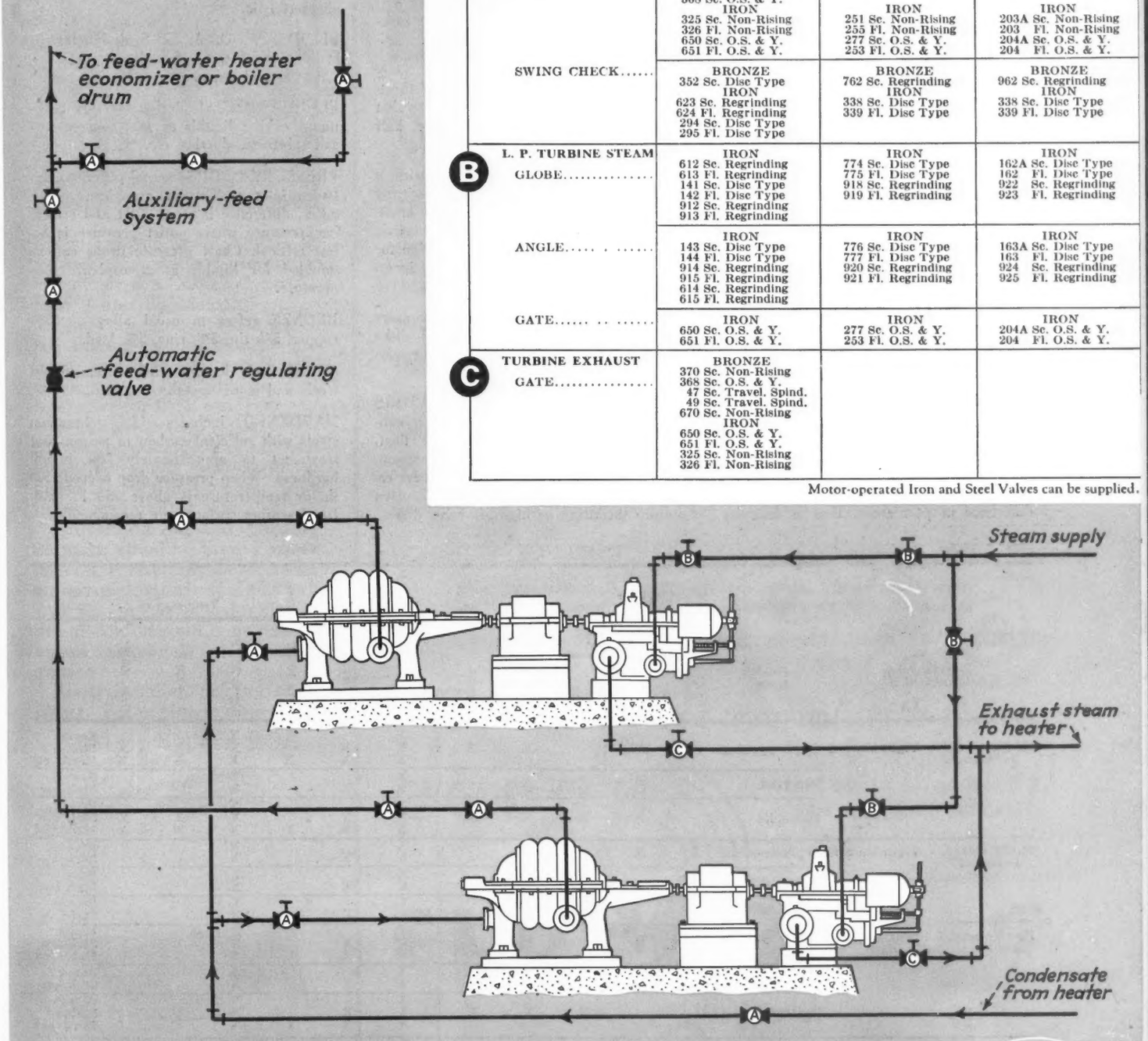
Que., Cote St. Luke—Canadian Industries, Ltd., 1135 Beaver Hall Sq., Montreal, plans nearing completion constructing 4 story, brick, steel, paint manufacturing plant, concrete foundation, 4 story varnish and 1 story power house, both steel frame, concrete foundation, also steel, timber warehouse, Clanvanald Ave. $100,000. L. de B. McCrady, 1155 Beaver Hall Hill, Montreal, engr.

Que., Quebec City—Champlain Brewery Co., Ltd., 164 Le la Corrone St., plans reconstructing brewery, Crown St., destroyed by fire. $150,000. Architect not appointed.

. . . TO *GOOD* VALVE PRACTICE

Jenkins RECOMMENDS . . .

STEAM AND WATER



REFERENCE CHART FOR JENKINS FIGURE NUMBERS

While Feed Pump Connections, Suction Lines L. P. Turbine Steam are usual in lower pressures, we have listed valves to include Extra Heavy.

		Standard	Medium	Extra Heavy
A	SUCTION LINES, AND WATER DISCHARGE GATE	BRONZE 47 Sc. Trav. Spind. 49 Sc. Trav. Spind. 370 Sc. Non-Rising 670 Sc. Non-Rising 368 Sc. O.S. & Y. IRON 325 Sc. Non-Rising 326 Fl. Non-Rising 650 Sc. O.S. & Y. 651 Fl. O.S. & Y.	BRONZE 270 Sc. Non-Rising 275 Sc. O.S. & Y. IRON 251 Sc. Non-Rising 255 Fl. Non-Rising 277 Sc. O.S. & Y. 253 Fl. O.S. & Y.	BRONZE 280 Sc. Non-Rising 282 Sc. O.S. & Y. IRON 203A Sc. Non-Rising 203 Fl. Non-Rising 204A Sc. O.S. & Y. 204 Fl. O.S. & Y.
	SWING CHECK	BRONZE 352 Sc. Disc Type IRON 623 Sc. Regrinding 624 Fl. Regrinding 294 Sc. Disc Type 295 Fl. Disc Type	BRONZE 762 Sc. Regrinding IRON 338 Sc. Disc Type 339 Fl. Disc Type	BRONZE 962 Sc. Regrinding IRON 338 Sc. Disc Type 339 Fl. Disc Type
B	L. P. TURBINE STEAM GLOBE	IRON 612 Sc. Regrinding 613 Fl. Regrinding 141 Sc. Disc Type 142 Fl. Disc Type 912 Sc. Regrinding 913 Fl. Regrinding	IRON 774 Sc. Disc Type 775 Fl. Disc Type 918 Sc. Regrinding 919 Fl. Regrinding	IRON 162A Sc. Disc Type 162 Fl. Disc Type 922 Sc. Regrinding 923 Fl. Regrinding
	ANGLE	IRON 143 Sc. Disc Type 144 Fl. Disc Type 914 Sc. Regrinding 915 Fl. Regrinding 614 Sc. Regrinding 615 Fl. Regrinding	IRON 776 Sc. Disc Type 777 Fl. Disc Type 920 Sc. Regrinding 921 Fl. Regrinding	IRON 163A Sc. Disc Type 163 Fl. Disc Type 924 Sc. Regrinding 925 Fl. Regrinding
	GATE	IRON 650 Sc. O.S. & Y. 651 Fl. O.S. & Y.	IRON 277 Sc. O.S. & Y. 253 Fl. O.S. & Y.	IRON 204A Sc. O.S. & Y. 204 Fl. O.S. & Y.
C	TURBINE EXHAUST GATE	BRONZE 370 Sc. Non-Rising 368 Sc. O.S. & Y. 47 Sc. Travel. Spind. 49 Sc. Travel. Spind. 670 Sc. Non-Rising IRON 650 Sc. O.S. & Y. 651 Fl. O.S. & Y. 325 Sc. Non-Rising 326 Fl. Non-Rising		

Motor-operated Iron and Steel Valves can be supplied.

JENKINS BROS., 80 WHITE STREET, NEW YORK, N. Y.

Bridgeport • Boston • Chicago — Philadelphia • Atlanta • Houston

TRADE JENKINS MARK — Jenkins Bros.

1864—1939 DIAMOND ANNIVERSARY

#8 OF A SERIES designed to help in your selection of JENKINS VALVES

Number 85

Regulating-Valve Selector Chart

THE CHART BELOW is a short cut to intelligent selection of valves for automatic control of pressure, temperature, flow and liquid level. Recommendation applies to valve only, whether actuated by diaphragm, electric motor, solenoid, or any other means. Only standard types are listed. Select least expensive combination of valve, regulator and trim having all X's for required service.

SINGLE-SEATED UNBALANCED VALVES are conventional, similar to hand-operated globe valves, are drop-tight and are generally used where operating force is large as compared to unbalanced force. Unbalanced force is product of seat-ring bore area and pressure drop. When unbalanced force exceeds 15% of available operating force, good practice demands balanced-valve construction.

SINGLE-SEATED BALANCED VALVES are balanced through an internal pilot valve, have long been used in control work, are drop tight. Some manufacturers do not offer this type for throttling.

SEMI-BALANCED DOUBLE-SEATED VALVES have flow entering between two beveled seats, one slightly larger than the other. Unbalanced force is proportional to difference in port areas. Due to difficulty of lapping-in for drop-tight seating, allow for one-half per cent leakage.

PISTON-BALANCED DOUBLE-SEATED VALVES have both seats of same size and are fully balanced. No positive seating surfaces are provided and leakage is a function of piston clearance; allow for a maximum of 3% leakage.

QUICK-OPENING DISKS have no throttling skirt below the seating surface so that little lift gives considerable flow; half flow occurs at about one-third opening.

V-PORTED DISKS are provided with a V-shaped throttling skirt below the seating surface. By variation in shape of the ports, a wide range of flow-opening characteristic can be had. Usual practice is to design for uniform increments of flow for equal increments of opening.

PARABOLIC DISKS have nearly the same high-lift characteristics as V-ported disks and are recommended for heavy-duty service.

DIRECT-CONNECTED REGULATORS depend on the fluid flowing to exert controlling force on a diaphragm or float, simplest type of control. Chart recommendations aim at high sensitivity; process requirements, particularly level control, often require throttling or high-lift valve disks.

AUXILIARY-OPERATED REGULATORS depend on pilots valve control of air, gas, steam, oil, water or electric source of auxiliary power. Control arrangement can be varied to give either on-off or throttling characteristic.

FLUIDS, W, O, A, G, S designates all ordinary clean water, low-viscosity oils, air, inert gas and steam.

FLUIDS, SPECIAL designates tars residuums, coking liquids or gas, concentrated salt solutions, slurries, etc.

PRESSURE DROP is actual difference between inlet and outlet pressures, or for gases, difference between inlet and critical backpressure where outlet pressure is below critical. Chart pressure drops can be doubled for liquids at atmospheric temperature.

BRONZE refers to usual alloy of 85% copper, 5% tin, 5% zinc, 5% lead.

STAINLESS denotes 18-8 chrome-nickel steels and monel metal.

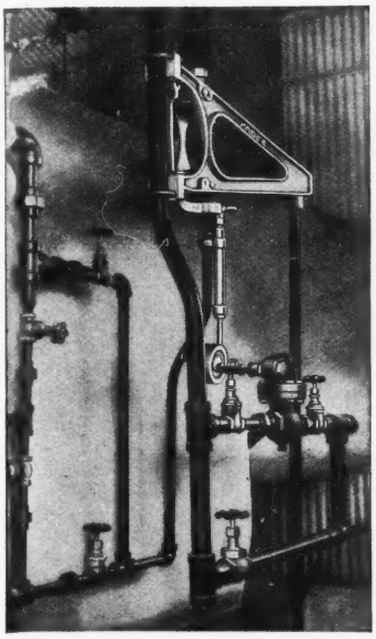
HARDENED includes 13% chromium steels with sufficient carbon to permit heat treatment to approximately 500 brinell hardness. When pressure drop exceeds 300 lb, or temperature is above 750 F, hard-faced seating surfaces are recommended.

Internal valve construction		Valve-disk types	Type of regulator: Direct connected	Type of regulator: Auxiliary operated: On-off	Type of regulator: Auxiliary operated: Throttling	Fluid: W,O,G,A,S	Fluid: Special	Pressure drop: Up to 50 lb	Pressure drop: 50–100 lb	Pressure drop: Over 100 lb	Temperature: Up to 350 F	Temperature: 350–600 F	Temperature: Over 600 F	Valve-trim materials
Single-seated, unbalanced	Tight shutoff	Quick-opening	X	X		X	X	X	X		X	X	X	Bronze
								X	X		X	X	X	Stainless
								X	X	X	X	X	X	Hardened
		V-ported			X	X		X			X			Bronze
								X	X		X			Stainless
		Parabolic			X	X	X	X			X			Bronze
								X	X		X	X	X	Stainless
								X	X	X	X	X	X	Hardened
Single seated, balanced	Tight shutoff	Quick-opening	X	X		X		X			X			Bronze
								X	X		X			Stainless
		V-ported			X	X		X			X			Bronze
								X	X		X			Stainless
		Parabolic			X	X		X			X			Bronze
								X	X		X			Stainless
Double-seated, semi-balanced	Leakage 2%, max.	Quick-opening	X	X		X	X	X			X			Bronze
								X	X		X	X	X	Stainless
								X	X	X	X	X	X	Hardened
		V-ported			X	X		X			X			Bronze
								X	X		X			Stainless
		Parabolic			X	X	X	X			X			Bronze
								X	X		X	X	X	Stainless
								X	X	X	X	X	X	Hardened
Double-seated, piston-balanced	Leakage 3%, max.	Quick-opening	X	X		X		X			X			Bronze
								X	X		X			Stainless
		V-ported			X	X		X			X			Bronze
								X	X		X			Stainless

By W A Diament

© POWER

COPES FOR SMALL BOILERS



If you operate small boilers at moderate ratings and pressures, investigate the COPES Type OT Feed Water Regulator.

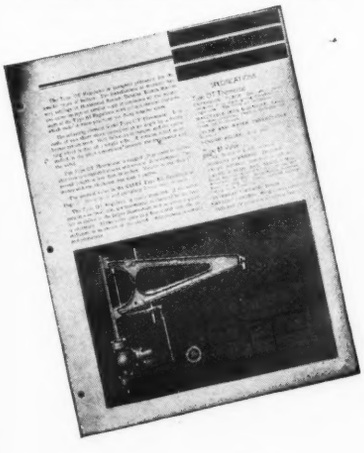
Feeds continuously to a working boiler, as needed for the level and furnace conditions. Gives more steam per pound of fuel; pays for itself quickly.

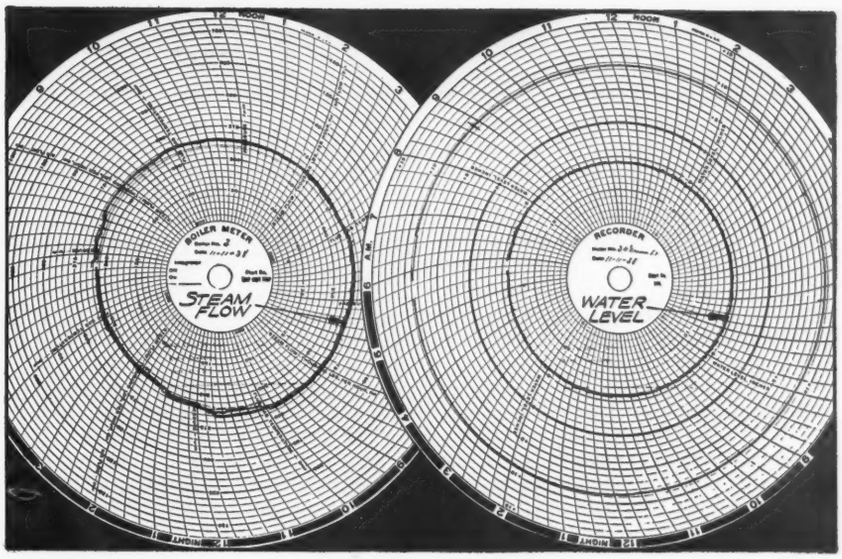
Stabilizes boiler water level, preventing damage from exposed tubes or water carry-over to prime movers or process. Your boiler operation is safer.

Fully-automatic and needing no more attention than a water column, it releases operators for more important duties than watching the water level. Simple design and rugged construction assure absolutely dependable service.

Easily installed on any small boiler. For complete data—

Write for Bulletin P-2A





Water Level: ± ½ Inch

At Southern Alkali Corporation, a COPES Flowmatic holds water level within plus or minus ½ inch on a 425-pound pressure integral furnace boiler. On test, it has demonstrated unusual ability to stabilize the level on rapid, wide load swings. Close level control means greater safety. Accurate gearing of feed input to steam output means higher efficiency. The COPES Flowmatic gives both these benefits. For the complete story of the Southern Alkali Corporation installation, write for Bulletin 417. On your letterhead, please.

NORTHERN EQUIPMENT CO., 811 GROVE DRIVE, ERIE, PA.

Feed Water Regulators, Pump Governors, Differential Valves
Liquid Level Controls, Reducing Valves and Desuperheaters

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REPRESENTATIVES EVERYWHERE

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COPES

FEEDS BOILER ACCORDING TO STEAM FLOW•AUTOMATICALLY

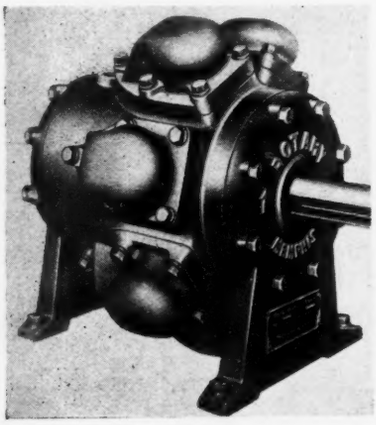
FLOWMATIC

★ REGULATOR

What's New in Plant Equipment

Elevator Pump

"ROTA-RADIAL" pump used on oil- or water-driven hydraulic elevators for freight, passenger or sidewalk service, said to have efficiency over 85%. Built on style of aviation engines, has 7 cylinders operating from an eccentric. Other features claimed

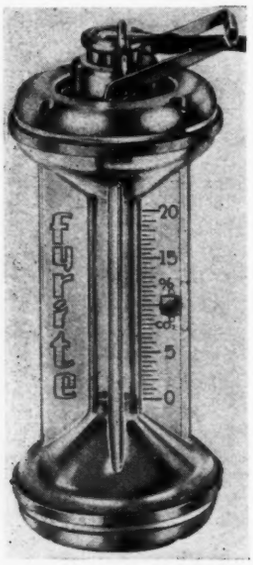


include: practically no slipping, resulting in better speed control, and ability to stop and start smoothly with or without elevator load. Motors of smaller horsepower used because of these features.

Rotary Lift Co, Memphis, Tenn.

CO_2 Indicator

"FYRITE," pocket-size indicator has no valves, clamps or leveling bottle. Fits in the hand and is built of clear plastic materials. In operation gas chamber is filled with flue gas to be analyzed. Sampling



hose is then detached, sealing instrument. To mix gas with absorption fluid, "Fyrite" is turned upside down, then back to normal. Suction created due to complete absorption of CO_2 pulls absorbing fluid in graduated tube an amount equal to CO_2 absorbed. This gives percentage of CO_2 in the gas. Entire operation takes about 1 min. Outfit comes complete with aspirator-bulb, filter, rubber tubing and metal sampling tube, together with carrying-case.

Bacharach Industrial Instrument Co, 7000 Bennett St, Pittsburgh, Pa.

Recording Thermometer

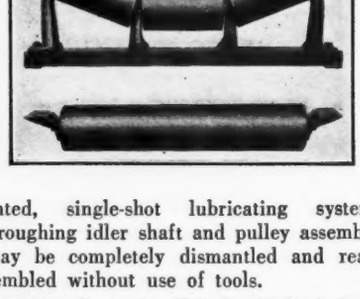
"SERVICEMAN" recorder has 1-day clock said to be accurate and adjustable. Thermometer unit also adjustable and has bimetal spiral, tested in service. Pen and

arm built to swing free of dial when changing charts. Charts available for all temperatures from −20 F to +110 F, in 45 and 90 deg ranges. Standard outfit comes with bottle of recorder ink and 50 extra charts.

Jas P Marsh Corp, 2073 Southport Ave, Chicago, Ill.

Troughing and Return Idler

ROLLER BEARING idlers have malleable-iron supporting brackets of streamlined design and crescent section, said to give maximum strength. Has new triple-seal assembly claimed to prevent escape of grease or entrance of dirt, grit or moisture, and pat-

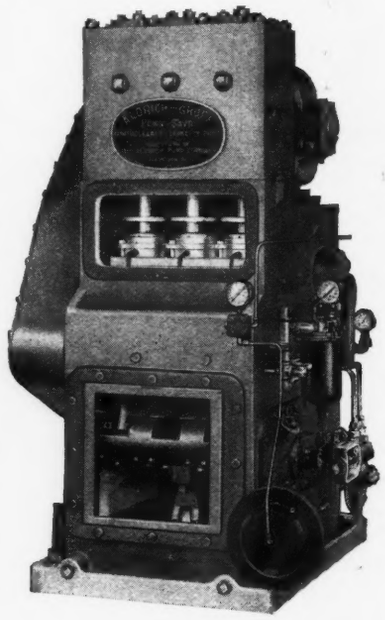


ented, single-shot lubricating system. Troughing idler shaft and pulley assembly may be completely dismantled and reassembled without use of tools.

Robins Conveying Belt Co, 15 Park Row, New York, N. Y.

Controllable Capacity Pump

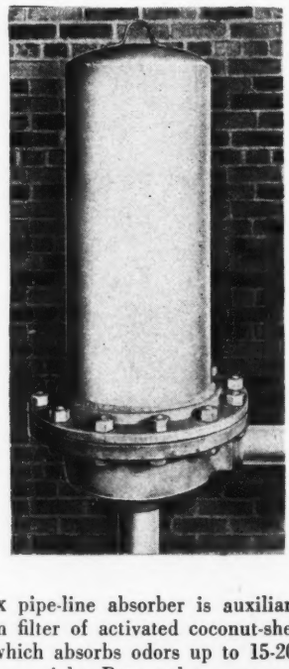
"POWR-SAVR" is reciprocating-plunger type pump built in vertical triplex arrangement with simple mechanical apparatus which governs length of plunger stroke, thus controlling the output from zero to maximum. Capacity can be controlled gradually, in stepless straightline fashion, to give any



desired delivery. Arrangement said to eliminate need for variable-speed motive power. Control of pump may be manual by handwheel or remote with special control systems.

Aldrich Pump Co., Allentown, Pa.

Odor Absorber for Compressed-Air Lines



DOREX pipe-line absorber is auxiliary air-stream filter of activated coconut-shell-carbon which absorbs odors up to 15-20% of its own weight. Reported to remove odors and vapors which cannot be stopped by

AMONG MEN WHO WANT MORE PUMP FOR LESS MONEY, SSUNITS ARE FIRST CHOICE!

ALLIS-CHALMERS SSUNIT PUMP, here shown pumping wort, is "first choice" of the chief engineer in this brewery . . . a man who knows the importance of getting high pumping efficiencies at low cost.

Real Dollar-Saving Performance . . . That's What Men Who Manage Plants Get With the Fast-Selling SSUnit Pump!

It's making news...this low-cost SSUnit Pump with extra-value features that give men, responsible for production in their plants, new lows in pumping costs!

Compact, husky design beats space waste . . . cuts maintenance costs! Bronze construction of the enclosed runner, wearing ring, and shaft sleeves means full protection against rust and excessive wear. Complete testing before delivery is your assurance that your SSUnit Pump can go to work for you the minute it is installed in your plant!

There's Full-Measure construction in the famous Lo-Maintenance Motor that drives the pump...the same Full-Measure Motor that has an outstanding record for standing up under conditions that many times wreck ordinary motors in a few weeks. No "buck-passing" . . . Allis-Chalmers accepts undivided responsibility for both motor and pump!

And the Allis-Chalmers engineering that originated the motor-coupled pump in 1926 is the same great engineering that designed and built the great Niagara Falls and Boulder Dam turbines!

These are plus features . . . plus features no other pump can give you. And they mean more gallons for less money!

Get the whole story of why hundreds of plants are switching to the new SSUnit Pump. Call the nearest district office or write direct to Allis-Chalmers.

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CENTRIFUGAL PUMP DIVISION

ALLIS-CHALMERS

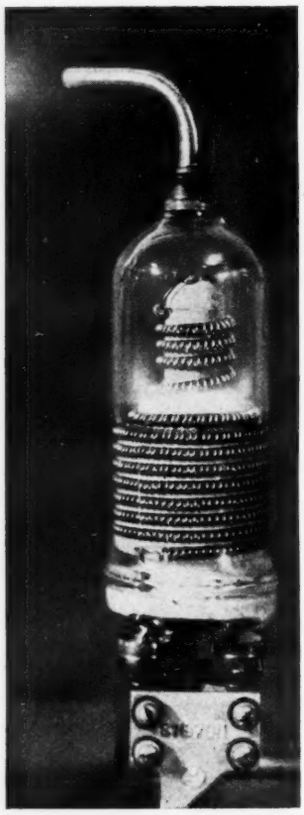
MILWAUKEE · WISCONSIN

condensers, separators or aftercoolers. Unit illustrated has compressed-air capacity of 175 cfm.

W B Connor Engrg Corp, Dorex Air Conditioning Div, 114 East 32nd St, New York, N.Y.

Flash Type Steam Generator

FLASH-TYPE heater can generate superheated steam from cold water in less than 15 sec, and is no bigger than ordinary incandescent lamp in size. Rated at a



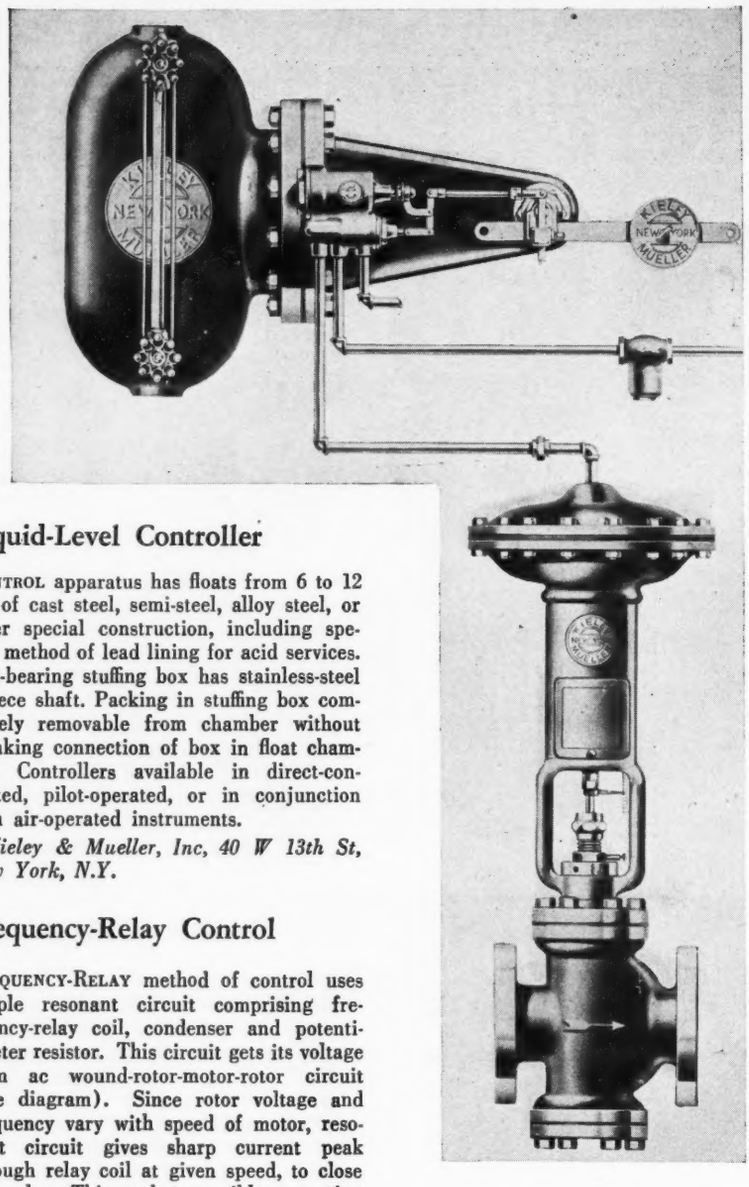
thermal efficiency of 90% because heating coils are directly in water, is made in 1000-, 1500-, and 2000-watt sizes, with evaporating capacities up to 5.7 lb of water per hr. Chemical-resistant case able to withstand internal pressures up to 25 lb psi and shock of tranference from hot to cold water and vice versa, without cracking. Suggested application include sterilizing instruments for doctors, and other applications in home, restaurant, and factory, where small amounts of steam are required quickly. Over-all size is 9¼ in.

Westinghouse Electric & Mfg Co, East Pittsburgh, Pa.

Hydraulic Elevator

"OILDRAULIC" elevator uses oil instead of water for motive power. Corrosive action of water eliminated; oil may be used over again. Uses 7-cylinder radial pump to force oil back into system. When in lowered position elevators form part of floor or loading-platform.

Rotary Lift Co, Memphis, Tenn.



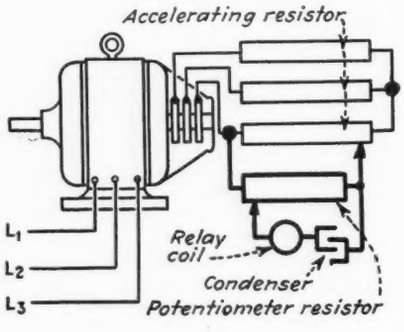
Liquid-Level Controller

CONTROL apparatus has floats from 6 to 12 in., of cast steel, semi-steel, alloy steel, or other special construction, including special method of lead lining for acid services. Ball-bearing stuffing box has stainless-steel 1-piece shaft. Packing in stuffing box completely removable from chamber without breaking connection of box in float chamber. Controllers available in direct-connected, pilot-operated, or in conjunction with air-operated instruments.

Kieley & Mueller, Inc, 40 W 13th St, New York, N.Y.

Frequency-Relay Control

FREQUENCY-RELAY method of control uses simple resonant circuit comprising frequency-relay coil, condenser and potentiometer resistor. This circuit gets its voltage from ac wound-rotor-motor-rotor circuit (see diagram). Since rotor voltage and frequency vary with speed of motor, resonant circuit gives sharp current peak through relay coil at given speed, to close the relay. This makes possible operation of relay at any predetermined frequency. Sliding-bar contact on potentiometer resistor provides vernier adjustment to ob-



tain exact operating results. Accuracy of control for wound-rotor motors permits matching motor accelerating torque to load requirements. On a quick stop, reverse-power contactor can be opened the instant motor stops by plugging controllers. Fast lowering speed secured on counter-torque lower controllers for ac crane and hoist motors. Relay quickly responds to any change in motor requirements, to check speed, hasten lowering of load, or accelerate motor in normal manner.

Electric Controller & Mfg Co, Cleveland, O.

Steel Electrodes

"CERTIFIED" stainless-steel electrodes feature weld deposit certification instead of wire analysis. Other claims include instant contact upon striking, maximum ease of slag removal, spatter free within practical limits, smooth bead with perfect weld contour, and all alloys contained in core wire.

The McKay Co, York, Pa.

Voice-Powered Telephone

TELFAIR "TELFONE", privately-owned intercommunication system, uses no magnets, or intricate parts, but is fully voice-powered. Handle of Model "T" is equipped with special transmitter and receiver sealed into handle. Attached to handle is 40-in.

You Audit Your Books C.I.A.

Why Not Your Water Conditions? BETZ

The Betz "Water Audit"—a professional, unbiased approach to water problems—has accomplished outstanding results in all fields of water usage. In the boiler field it has been especially beneficial in establishing very low blow-down rates and solving difficult carry-over problems resulting in steam purity. Significant reductions in operating, maintenance and treatment costs are usually realized.

Betz offers a complete Advisory and Consulting Service by an organization of Chemical Engineers possessing unsurpassed technical ability, advanced experience and complete research facilities. Betz Service—based on facts—involves a critical survey and report of your plant's water conditions—together with exact, complete and unbiased recommendations on treatment or methods for the solution of any water problem.

Put your plant under the watchful eyes of these engineers. Write for pamphlet "Answers to your questions," describing Betz Service.

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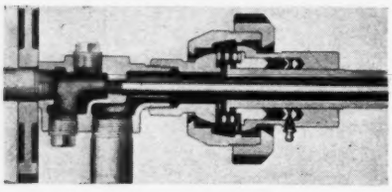
wire finished at the end and equipped with spade tips and a stay hook. Two instruments when connected together by 2-conductor wire, and used in conjunction with signalling system make complete communicating system with transmission and reception good for over 200 or 300 ft. When used with wall or desk stands, communications may be carried on over several miles. Other models available for home, camp, apartment house, and offices.

Telfair Telfone Corp, West Orange, N.J.

Revolving Joint

BARCO revolving joints constructed to supply steam, gas or other fluids from stationary supply pipe to rotating drum or member without leakage. Rotating sleeve is only part of joint which revolves, also sliding in or out to compensate for any



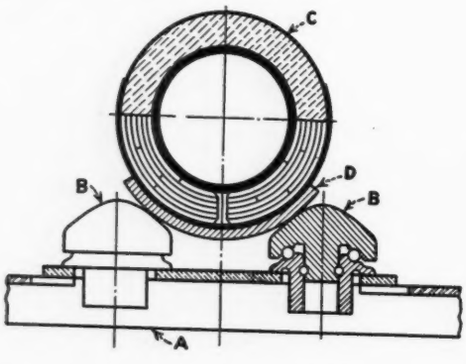
end play in revolving drum. Double-ball design provides flexibility to take care of misalignment or eccentricity of movement. Adapter is used when two different fluids are to be fed into drum, or condensate is to be removed through same opening.

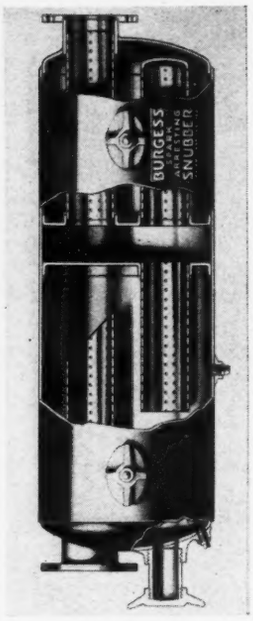
Barco Mfg Co., 1801-1815 Winnemac Ave, Chicago, Ill.

Ball-Bearing Pipe-Support

BALL-BEARING cones as pipe suports consist of horizontal piece *A* carrying 2 conical rollers *B*, with supporting surface cast with vertical pin guided in bearing sleeve. Ball bearing permits free rotation for any longitudinal motion of pipe, and flange seals out dirt. Cone assemblies inserted in slots and held there by weight of pipe *C*. Slotted plate has holes to correspond. Plate permits opposite movement of pipe without affecting relation of cone axes. Cast-iron shoe, *D* is fastened to semi-circular section of laminated insulation the same thickness of pipe covering, reducing heat loss. Ring prevents separation of parts without hindering rotation.

United Engrg Co, Ltd, San Francisco





Exhaust Snubber

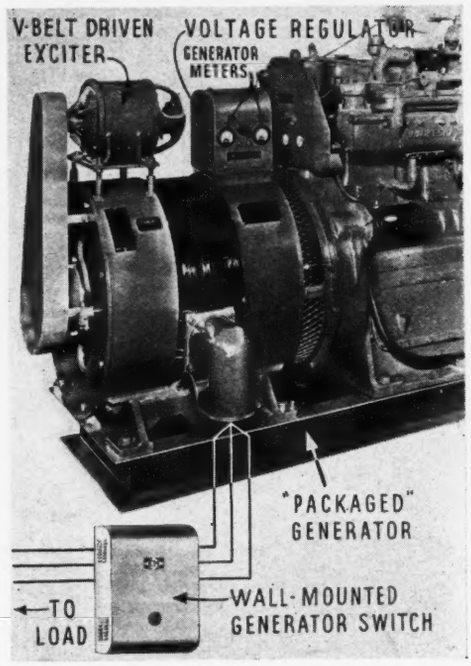
BURGESS SDHS SNUBBER snubs the charges of high-velocity exhaust gas that rush into exhaust pipe and bleeds same before noise can be made. Also prevents building up of line surges and peak back-pressures. Large cross-sectional path reduces velocity of gases, and finer carbon particles are removed by centrifugal action to chamber in bottom of snubber. Unit works with all engines, but must be installed vertically. Available in 19 standard sizes with connections ranging from 2 to 30 in. in diameter, flanged to match 125-lb pipe-flanges.

Burgess Battery Co, Acoustic Div, Dept NR, 500 W Huron St, Chicago, Ill.

Transformer Cooling Fan

PORTABLE cooling fan said to increase transformer capacity and life by removing heat film from plates through scrubbing action of air. Blades of cast aluminum alloy are driven by Diehl watertight motor, rated at 1 hp, 1750 rpm, 2- or 3-phase, 60 cycles, for all standard voltages. Has 5000 cu ft capacity in free air, and 3000 cu ft capacity with 1-in. static pressure. Fan and motor mounted on base, which can be adjusted to tilt fan from horizontal to vertical position. Weighs 145 lb and over-all height is 38 in. Form No. 1931.

Diehl Mfg Co, Elizabethport, N.J.



Packaged A-C Generating Unit

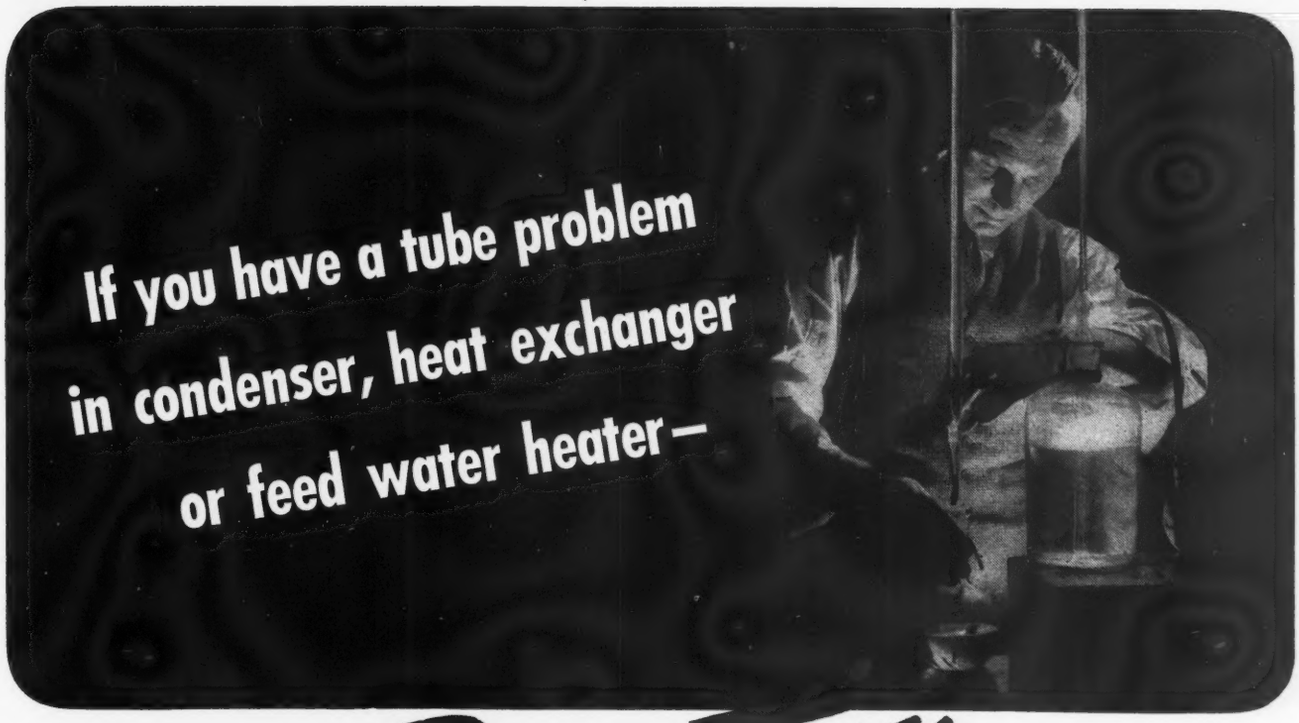
"PACKAGED" GENERATOR is high-speed ac generating unit. Stator frame fabricated by welding from bar- and plate-steel, supported by rigid cradle-foot structure. Rotor of conventional design provided with welded squirrel-cage winding in poleface. Exciter V-belt driven and mounted so that belt tension can be adjusted easily. Automatic voltage regulator and meters, assembled in compact unit, also mounted on the generator. Only separate equipment is switching unit for wall-mounting. Requires only three wires from generator to switch and three wires to load. When unit is in parallel with another unit it is made self synchronizing by automatic synchronizer, which operates within generator speed zone of 97 to 103% synchronous speed. As soon as incoming generator reaches proper speed, generator switch closes automatically first time generator voltage comes into phase with bus voltage. Design provides compact small-capacity unit, driven by high-speed diesel engines or other sources of motive power, that is simple to operate.

Electric Machinery Mfg Co, Minneapolis, Minn.

Coal-Stoker Controls

"STOK-A-TIMER" has heat motor instead of usual synchronous motor. Operated by two loop-shaped bimetal coils which are alternately heated and cooled by low-voltage strip-heater. As one coil is heating, other is cooling, and both move and supply power to ratchet mechanism which is connected to rotating member. When temperature differences between two coils reaches certain point, snap action mechanism flips heater element away from one coil and against the other. Process of

(Continued on Page 134)



A Suggestion

Nominal Compositions of Anaconda Condenser Tubes

Alloy	*Copper %*	*Nickel %*	*Zinc %*	*Aluminum %*	*Tin %*	*Arsenic %*
Super-Nickel 701	70	30	0	0	0	0
Cupro Nickel 712	80	20	0	0	0	0
Ambrac* 850	75	20	5	0	0	0
Ambraloy* 901	95	0	0	5	0	0
Ambraloy* 927 (Patented)	76	0	21.95	2	0	0.05
Admiralty Alloy 442	70	0	29	0	1	0
Arsenical Admiralty 439	70	0	28.95	0	1	0.05
Red Brass 85%	85	0	15	0	0	0
Tobin Bronze* 452	60	0	39.25	0	0.75	0
Muntz Metal 65	60	0	40	0	0	0
Copper, Arsenical Deoxidized 108	99.63	0	(Phosphorus, 0.02%)		0	0.35

*Trade-marks Reg. U. S. Pat. Off.

Anaconda Tube Sheets

We produce a complete line of plates and circles for marine and stationary condensers, heat exchangers, feed water heaters and oil coolers. The same careful technical supervision used to control the manufacture of Anaconda Condenser Tubes is given this material during the entire process of production.

THE service life of condenser tubes is determined in the main by the interrelationship of such operating factors as condenser design, temperatures, character and velocity of the cooling water and the presence of air or solid matter in the water. Actual service conditions thus set up are so many and varied that no one tube alloy can solve all problems.

To determine the tube alloy that will give the greatest service per dollar of cost in your plant, we suggest that you consult with our engineers. Having a rich background of metallurgical experience and a practical knowledge of operating practices, they are particularly well equipped to cooperate with you in the selection of condenser tube alloys to meet any given set of conditions. Naturally, their services are at your disposal without cost or obligation.

39121

Visit the Copper & Brass Industry Exhibit in the Metals Building, New York World's Fair—1939.

©N. Y. W. F.

ANACONDA
from mine to consumer

Anaconda Copper & Brass

THE AMERICAN BRASS COMPANY, General Offices: Waterbury, Connecticut

In Canada: Anaconda American Brass Ltd., New Toronto, Ont. • Subsidiary of Anaconda Copper Mining Company

Horse Sense . . .

The Army tells non-coms one good way to settle fights in their outfits. Of course, they can always tell the fighters to put the gloves on, but then the biggest guy wins — and the fight still goes on down inside. The other way, according to the *Reader's Digest,* is to set the scrappers to work washing opposite sides of the same window. After they glare at each other a while, they've just got to relax and grin.

Navy officers are tipped off to another psychological dodge in the Philippines. Most house servants there are coolies, not above walking off with the boss' possessions when he's not looking. Of course you can fire a thief, but the next one knows the same tricks. The coolie tries moving something that's caught his eye — moving it just an inch or two. Next, he tries putting it some place else in the room, generally nearer the door. If there's still no trouble, he figures the Boss didn't notice when it was moved, so won't notice if it's gone.

The way to beat it is just as simple. The coolie is taught that everything in a room has a certain place, and must go back there. As soon as he moves it a fraction of an inch, he's told about it. That stops excursions to the door before they start.

These are just good old horse sense, both ways of getting a certain result by doing something else, like smacking your lips over a teaspoonful of the kid's castor oil. The chief who walks through the boiler room and stops to clean up a gage glass, or who picks up a handful of oily waste and puts it in the can sets an example that beats any "Clean Plant" sign ever invented. His men figure it must be important if he does it himself, and usually see they do it themselves after that.

There's an old saying about the longest way 'round being the shortest way home. Don't forget it. Lots of times, a little thinking will fix up a problem that a bawling out won't. But be careful that your psychological trick doesn't backfire. Remember the story of the pup who made a mess of the floor. His master, being psychological, rubbed the pup's nose in it and threw him out the window. The next day the same thing happened — to the rug, and to the pup. The third day the pup made a mess, but when he saw his master coming, he rubbed his own nose in it and jumped out the window. It was too much psychology for that much pup.

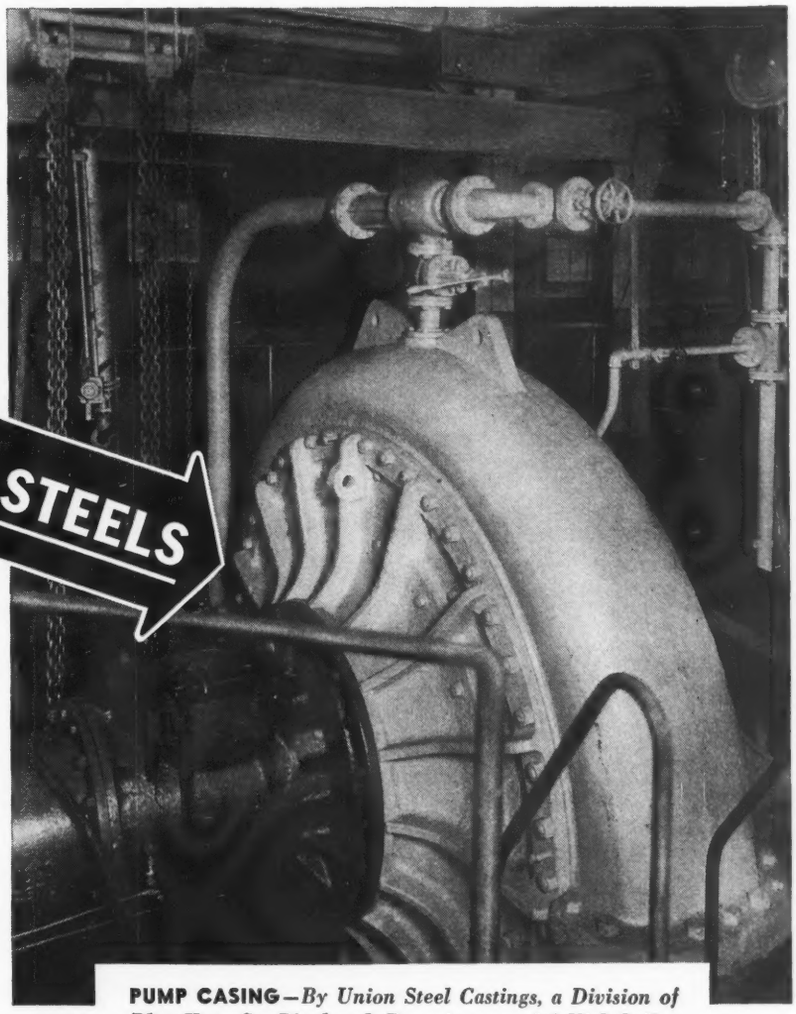
George Edwards

Engineer

ABRASIVE SILT BALKED

. . . when U. S. Army Engineers handle it with tough, long-wearing

NICKEL ALLOY STEELS



PUMP CASING—*By Union Steel Castings, a Division of Blaw-Knox Co., Pittsburgh, Pa., using a cast 2% Nickel alloy steel. Impellers are made of the same material to resist the extreme erosion and abrasion encountered by these parts.*

Along 30,000 miles of waterways, U. S. Army engineers work ceaselessly to protect river channels, keep harbors clear. This sea-going Army operates a huge fleet of work boats, such as this Diesel-powered dredge "Jewett."

The "Jewett" now serving on the Ohio River, is said to be the largest cutter head suction dredge built on inland waters. From Diesel power plant parts to pump liners, Nickel alloyed irons and steels have "signed on for the duration," which means many years, for materials strengthened with Nickel are unusually tough and long-lived. SAE 3340 (3½% Nickel—1½% chromium) steel plate, heat treated for high strength and hardness to resist the severe wear encountered, is used for the liner application.

For a host of marine applications there are Nickel alloyed materials which have proved most economical. Consultation on your problems involving the use of Nickel is invited.

• • •

DIESELS—*Busch-Sulzer for propulsion. Winton (General Motors) for generators. Both use alloys strengthened and toughened with Nickel in vital parts subject to heat, pressure, stress and wear.*

DREDGE "JEWETT"—Built by Dravo Corp., Pittsburgh.

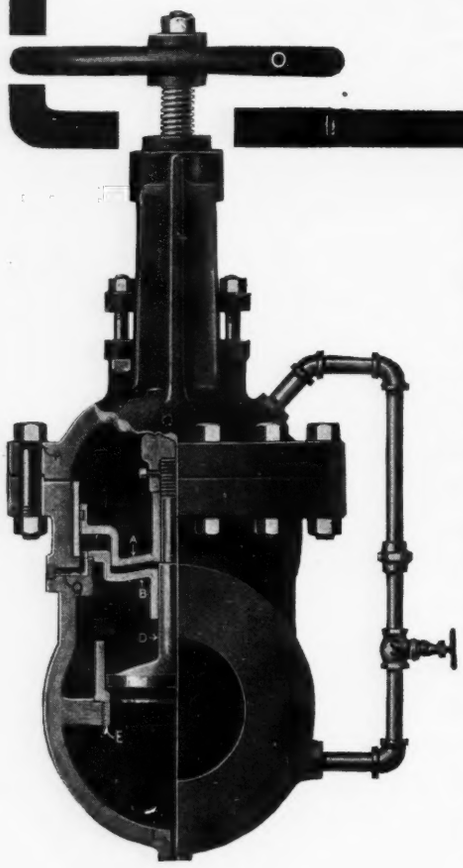
THE INTERNATIONAL NICKEL COMPANY, INC., 67 WALL ST., NEW YORK, N. Y.

★

Golden-Anderson

SPECIALTY

VALVES



THROTTLE AND EMERGENCY STOP

Automatically shuts down any over-speeding engine or turbine. Works *instantly*. Operates mechanically, electrically or by hand. Can be tripped from remote points by the push of a button. No engine or turbine can go faster than the maximum speed set for safe operation, when equipped with this valve. Hundreds in use, on all types of steam engines and turbines. Made in angle and globe patterns, in sizes from 2½" to 16", any pressure.

Ask for details and catalog of entire G-A line.

also

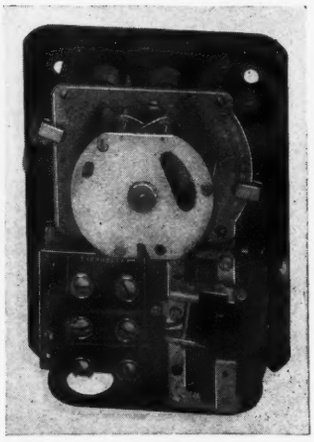
Triple Acting Non-Return . . . Pressure Reducing . . . Altitude Control . . . Float Control . . . Check Valves, etc.

Golden-Anderson Valve Specialty Co.

Fulton Bldg. • • • Pittsburgh, Pa.

New Equipment

(Continued from page 130)



heating and cooling causes rotating member to make one rev per hr and to fire stoker in accordance with dial settings. Electrical capacity is 10 amp, 115 v, 5 amp, 230 v. Motor rating 1-hp repulsion-induction, ½-hp split-phase.

Mercoid Corp, 4201 Belmont Ave, Chicago, Ill.

Fire Observer

OBSERVATION port covered with pyrex glass allows operator to inspect interior of furnace or fuel bed while fire is burning. Port is 6x4½ in., covered on inside by a shutter. Shutter allows no air in or out,

and when raised, lets operator see interior of furnace; when released, covers port entirely. Glass is protected by monel metal screen when shutter is open.

Detroit Stoker Corp, Detroit, Mich.

Welding Electrode

"STAINWELD C" electrode provides weld-metal of physical and chemical properties for welding stainless steels containing 3½% molybdenum. Coating on electrode said to prevent oxidation of weld-metal and keep analysis of deposited metal almost the same as welded metal. Physical properties of electrode similar to 18-8 stainless steel. Packed in 25-lb packages in 3 sizes: ⅛, 5/32, 3/16 and 11½ in.

Lincoln Electric Co, 12818 Coit Rd, Cleveland, Ohio.

"LESS TIME OFF THE LINE"—Say users!

"EASY TO CLEAN AND INSPECT"

"WE have found them to be very economical as to upkeep," says a prominent Springfield user with 12 years' experience. "Repairs and maintenance have been very low and we have found them particularly easy to clean and inspect."

"GOOD FOR LONG PERIODS OF CONTINUOUS SERVICE"

"ESPECIALLY good for long periods of continuous service," is the comment of an experienced operating engineer who adds: "We operate this one six months on continuous night and day load. It is never off the line for a minute during that time and it could be operated a year that way just as easily."

PUT IN NEW TUBES FOR FIRST TIME IN 20 YEARS!

THE user of two Springfield units installed more than twenty years ago adds confirmation to the experience of many others: "We have had very little trouble with them and are now putting in new tubes for the first time."

THERE are a number of basic reasons why users of Springfield boilers invariably report their satisfaction with the long service, low upkeep costs, good efficiency, and high availability obtained. These are the same reasons why Springfield is called "The most practical boiler for many plants!" We will be glad to give the complete story. No obligation.

SPRINGFIELD BOILER COMPANY

Springfield, Illinois

CHICAGO • PHILADELPHIA • DALLAS • OSWEGO
CINCINNATI • BATON ROUGE • NEW YORK • BOSTON
DETROIT • PITTSBURGH • MINNEAPOLIS • MEXICO CITY

SPRINGFIELD

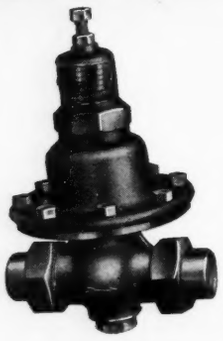
STEAM GENERATING UNITS

SPRINGFIELD BOILERS

ANY SIZE
ANY FUEL
ANY PRESSURE

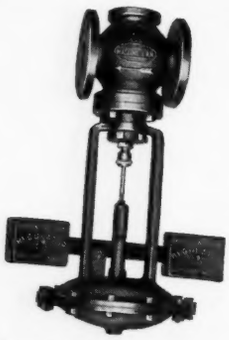
Is your heating system

ALL SET? Now is the time to begin checking up on your heating system—*before* you need it. And while you are checking make sure your steam pressure regulators are the right type for your particular system. If they need replacing we suggest that you investigate Masoneilan Regulators—the line that is "built up to the job not down to a price". Savings in maintenance and extra long life often more than pay for the regulator. Ask your mill supply distributor for complete details on these regulators—or write for Bulletin No. 64.

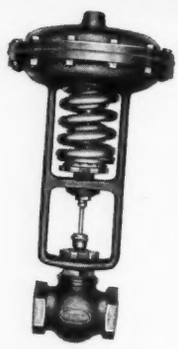


No. 33—for small unit heaters or single radiators. Has bronze body, stainless steel trim, union ends, tight shut-off. Sizes up to ¾". Pressure ranges between 2 and 100 lbs.

No. 12—for low pressure systems and unit heaters. Pilot operated. Bronze body, stainless steel trim, union ends, tight shut-off. Bronze sizes up to 2". Iron sizes 2-½" to 4". Pressure range 0 to 15 lbs.



No. 236-A—for general heating systems. Very sensitive. Standard iron bodies with bronze trim or extra heavy iron bodies with stainless steel trim, sizes up to 8". Pressure ranges between ½ and 40 lbs.



No. 509—for general or unit heating systems. Bronze body with bronze or stainless steel trim, screwed ends. Sizes up to 1-½". (Larger sizes also available). Pressure ranges between 2 and 120 lbs.

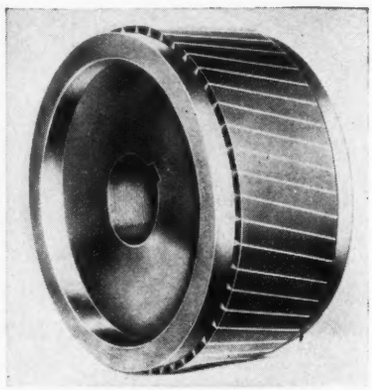
1186 Adams St., Boston, Mass., U. S. A.

New York Buffalo Philadelphia Pittsburgh
Chicago St. Louis Tulsa Houston Los Angeles

MASONEILAN

Copper Rotor

COPPERSPUN rotor winding pure copper. Rotor bars and one end ring formed by pouring molten copper into mold that holds

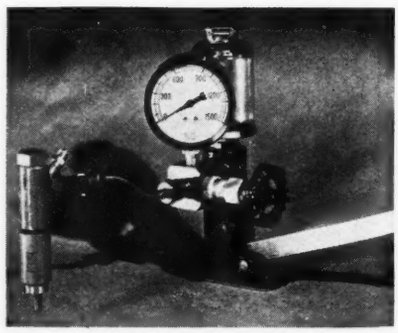


punched laminations, stacked and held under pressure. Copper is poured into one end as entire mold is spun at high speed. Opposite end ring formed by material which has passed through rotor slots during casting process. After casting, rotor is machine-finished over all surfaces, and fans are either welded to rotor or shaft-mounted, depending on type of motor.

Fairbanks, Morse & Co, 600 S Michigan Ave, Chicago, Ill.

Diesel Injector-Tester

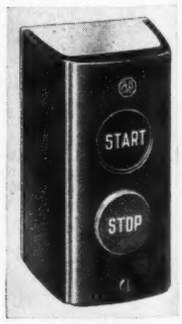
PORTABLE hand pump diesel fuel-injector-tester weighs but 6 lb, with handle 2 lb more. Tests injectors made by Deco, Hesselman, International, and others. Injectors



can be tested without removal from engine block. Plunger, barrel, suction and delivery valve identical with those in Deco fuel-injection pumps.

Diesel Equipment Corp, 4401 N Ravenswood Ave, Chicago, Ill.

Push-Button Control



UNIT TYPE push-button control station with reinforced bakelite cover mounted on die-cast frame; single- or double-button models. Cover can be taken out by removing single screw.

Try this TOMATO TEST!

On a level stretch of highway, with a fresh fill of your present oil, approach a roadside marker [tree or pole] in high gear at 10 miles-per-hour. As you pass it, push throttle to floor and hold it there. The instant your car accelerates to 60 miles-per-hour throw a marker on the road [tomato, egg or small sack of flour]. Now repeat exactly the same test with a fresh fill of RING-FREE, same SAE grade. Then get out and pace off the difference in distance between the 60 miles-per-hour markers. You'll be surprised! Important: be sure to let each oil circulate thoroughly through motor before starting these Acceleration Tests.

Mark this well: A motor oil has to be super-sure of itself before it urges you to make such a tell-tale test yourself. But, frankly, we're not worried. We know what Macmillan Ring-Free Motor Oil can do in your car... because we know what it has done, for more than 7 years, in millions of motors: gasoline, diesel and natural gas engines.

We know that, even in 24 hours, Ring-Free will produce a wholly new "feel" at the wheel. How? By reducing friction; by delivering more push-and-power. And, in the friction-fighting process, this amazing oil removes carbon; saves gas and oil; cuts wear and repair.

We ask you to take your own word ... not ours! Try this Tomato Test! See for yourself! Ask your service station, garage or car dealer for Macmillan Ring-Free Motor Oil. If he hasn't got it, he can get it for you.

MACMILLAN PETROLEUM CORPORATION

50 W. 50TH ST., NEW YORK • 624 S. MICHIGAN BLVD., CHICAGO • 530 W. 6TH ST., LOS ANGELES

Look for the sign of the Thrifty Lubricant

No other motor oil in America does ALL these things:

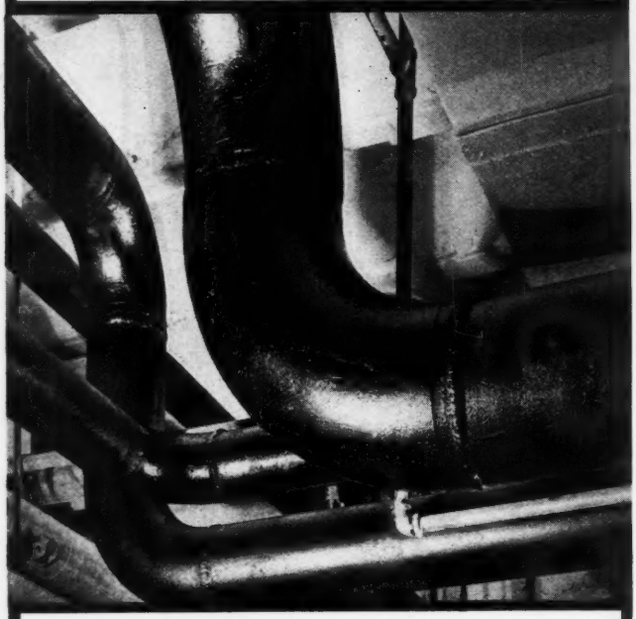
1 - GREATER FILM STRENGTH
2 - HIGHER HEAT RESISTANCE
3 - LONGER CLING TO METAL
4 - FASTER PENETRATION
5 - NON-CORROSIVE
6 - REMOVES HARD CARBON
7 - LESS AFFECTED BY DILUTION

Reproduced from Time and the Saturday Evening Post

Diesel operation is the toughest test of a motor oil ... and that's where Ring-Free shows its stuff!

After a 100-hour test with Ring-Free, compression checks will show extra power. For proof, call the Macmillan Man or write us direct.

Insist on these EIGHT FEATURES



-the welder knows their value

THE eight features of WeldELLS, illustrated here, do their own talking to the man who does the welding. There is no hunting for fittings, or "sizing up", because the name, size and weight are rolled into every Taylor Forge Fitting. Lining up is made easy by the quarter-markings at the ends. Welding is a quick, gratifying job thanks to the ample tangents, the clean, machine-tool bevels and the uniform accuracy of these engineered fittings.

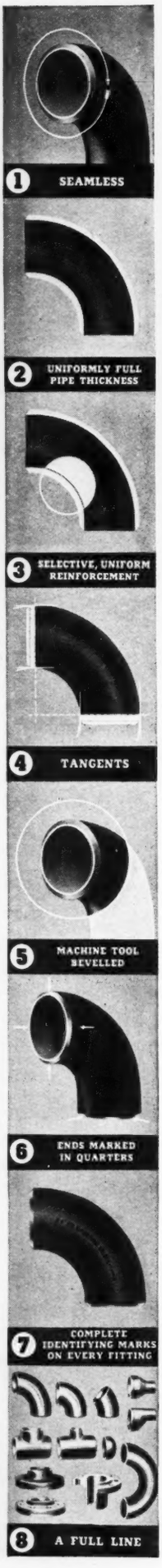
The finished job is better too—because it is made with fittings in which all walls are at least full pipe thickness with selective reinforcement in regions where greatest strain occurs.

Ask for latest bulletin.

TAYLOR FORGE & PIPE WORKS

General Offices and Works: P. O. Box 485, Chicago

New York Office: 50 Church St.


1 SEAMLESS
2 UNIFORMLY FULL PIPE THICKNESS
3 SELECTIVE, UNIFORM REINFORCEMENT
4 TANGENTS
5 MACHINE TOOL BEVELLED
6 ENDS MARKED IN QUARTERS
7 COMPLETE IDENTIFYING MARKS ON EVERY FITTING
8 A FULL LINE

TAYLOR FORGE

WeldELLS

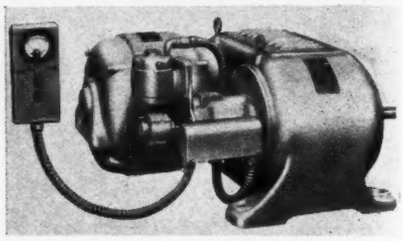
Seamless Pipe Fittings for Welding

which exposes all terminals. Mechanism can be removed from frame, and double-break, silver contacts are located in set-back niches.

Allen-Bradley Co, 1311 S First St, Milwaukee, Wis.

Speed Indicator

ELECTRIC REMOTE speed indicator for use with U.S. Varidrive Motor, controls speed remotely. Consists of meter as indicator mounted in box with push-button for controlling electric pilot that changes speed. Indicator calibrated in divisions from 1 to

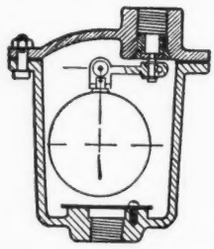


10, but scale may be calibrated to suit purchaser. Remote indicator station may be replaced by single push-button-station or automatic-control equipment.

U.S. Electrical Motors, Inc, Los Angeles, Calif.

Air Release Valve

SILVERTOP consists of valve, seat, lever and ball float inside of case. Inlet shown at bottom and air vent is at top. Liquid raises float and holds valve closed and accumulation of air or gas lowers liquid



level, causing float to drop. This opens valve and vents air or gas. Standard model available in six sizes, from ½ to 2 in., for pressures up to 250 lb psi. Other models built for pressures up to 1000 lb.

V D Anderson Valve Co, Cleveland, O.

Multi-Arc Welder

MODEL WA-200 has two major parts—one-piece frame and rotating member, all outside attachments removed. Welding range of 40 to 225 amp offered. Brushes and commutator may be removed for inspection or cleaning, and entire welder can fit in less than 3½ sq ft floor space. New type patented frame provides rigid construction, protects against misalignment of bearings and aids in elimination of vibration. Rotating member is balanced, statically and dynamically. Unit comes either

Private Letters OF AN OLD ENGINEER

No. 2
OF A SERIES
(A Scovill Service to You)

Dear Sam:

Before you spend $15,000 for that new tube sheet, listen to the experience of a friend of mine who's operating a unit like yours and was having the same sort of troubles — chronic leaks at the ferrule and packed joints.

Luckily, he called in Scovill, and after their analysis of the situation they suggested a method of tube installation with bushings, tube expansion and flaring which eliminated the leaks, and made the new tube sheet unnecessary. Meanwhile his power output was not seriously interrupted.

Now of course I can't guarantee that Scovill is going to step into your plant and turn the trick just like that — but I do know that Scovill engineers are on their toes and if anybody can save your fifteen thousand, they can.

More than that, you can expect their product to be on a par with the good judgment involved in their analysis of your problem. I've seen them turn out their tubes and I've seen them testing, so I know.

Finally, you'll get continued service after the installation is in. They're always eager to keep in touch with how things are going, and you'll find that their interest can be valuable to you.

I appreciate your letting me in on your problem, and I'm confident my suggestion will get you out of your trouble.

Bill

"Scovill Condenser Tubes" is a free booklet compiled by the Scovill engineer Bill mentioned. Address 13 Mill Street, Waterbury, Connecticut.

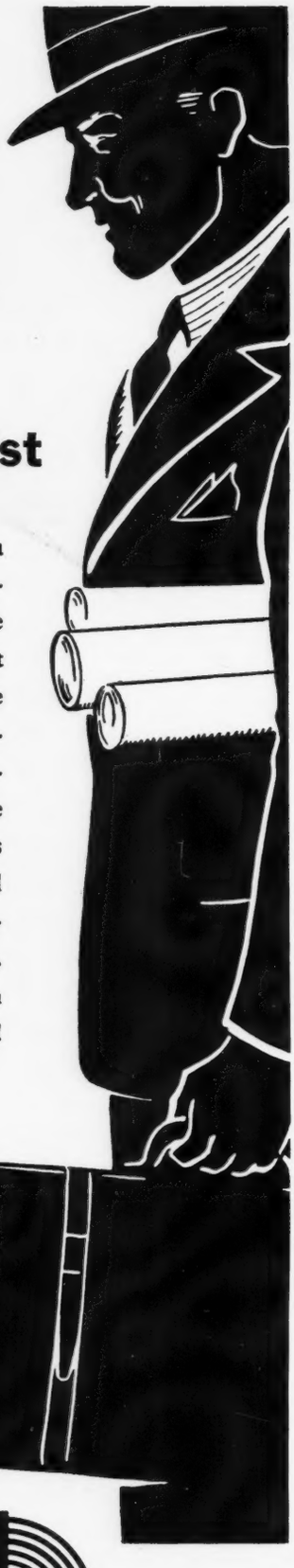
SCOVILL Masters of Metal

SCOVILL CONDENSER TUBES

one product . . . three services

PRODUCT ENGINEERING FIELD ENGINEERING ENGINEERING DATA

THIS MAN CAN HELP YOU



He's a Water Treatment Specialist

"THE SCAIFE MAN" is a good man for you to meet and know at any time—but particularly when you have a really bothersome boiler feed water problem to discuss. Let him shoulder your difficulty! His acute knowledge of proven techniques in handling power plant water has been demonstrated in successful cooperation with the largest as well as the smallest plants . . . his readiness to serve you is immediate . . . and back of him are the full resources of a long-established leader in water conditioning.

A consultation does not obligate you in any way. Call in The Scaife Man today!

SCAIFE

MANUFACTURES FOR THE POWER INDUSTRY:

Water Softeners: Hot Lime Soda . . . Cold Lime Soda . . . Sodium Zeolite . . . Hydrogen Zeolite.
Water Filters: Gravity . . . Pressure.
Continuous Blowdowns; Zeolite Minerals; Filter Refills.

Let us quote you!

FOUNDED SCAIFE 1802

WM. B. SCAIFE & SONS CO.
General Office, Laboratory and Works—OAKMONT, PA.
(Pittsburgh District)
Representatives in Principal Cities

with fixed legs for stationary service, or wheels for portable duty.

Harnischfeger Corp, 4400 W National Ave, Milwaukee, Wis.

Air Eliminator, Automatic Bypass

No. 10 high-pressure air eliminator is used for drying and automatic venting of unit-heaters, pipe-coils, dryers, etc, under steam pressures from 0 to 25 lb. Automatically

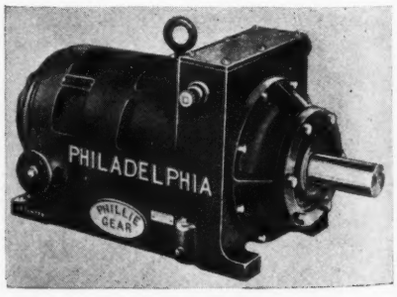
bypasses extra condensation if it accumulates. Operating unit closes eliminator at 212 F and holds it closed until temperature drops below that point.

Gorton Heating Corp, Cranford, N. J.

Safety Motor Shutoff

"PLANATORQUE" MotoReducer is motor drive that provides protection for agitators, mixers, conveyors, etc, which become jammed or overloaded. When speed exceeds certain limit, compressed torque spring turns off power switch. Unit is ready for re-starting as soon as overload is removed. Units furnished for vertical or horizontal drives, for all horsepowers and ratios, and for clockwise or counter-clockwise rotation.

Philadelphia Gear Works, Philadelphia, Pa.



WE'RE USING 25% MORE STEAM AND PAYING $321 LESS FOR FUEL

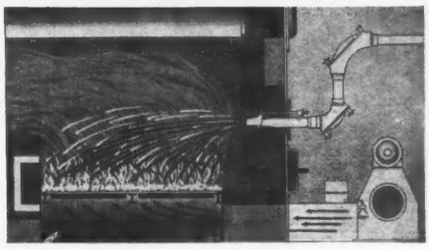
AN IRON FIREMAN "SPREADER" STOKER HAS CUT OUR FIRING LABOR COST 50%, TOO!

IRON FIREMAN
Industrial Stokers 2-to-1 Favorites

Here's the Kind of Performance that Put Iron Fireman on Top

SUPERIOR PERFORMANCE—that's the reason American industry's installations of Iron Fireman industrial stokers outnumber those of the next leading make by *more than 2-to-1.* Here is an example of this superior performance:

Before the Hofmann Packing Co. modernized its boiler room, its average annual fuel cost, for hand-fired coal, was $2121. Two and a half years ago Hofmann installed an Iron Fireman Pneumatic Spreader stoker. Since then, with a steady increase in business, steam consumption has jumped 25%. Yet the cost of fuel with Iron Fireman firing has averaged only $1800 a year—a cash saving of $321! At the same time, reports President A. C. Hofmann, labor in the boiler room has been reduced 50%, "and we do not have the wide variation in steam pressure that we formerly had with hand-firing."



Above: N. L. Hofmann, treasurer (left); and A. C. Hofmann, president. *Right:* The Iron Fireman Pneumatic Spreader—the type of stoker installed in the Hofmann plant. The coal is conveyed from hopper to boiler on a stream of high-velocity air. Fines burn in suspension; lumps burn in a shallow layer on the grates. The Iron Fireman Pneumatic Spreader is highly responsive—heavy withdrawals of process steam are quickly offset. In case of electric failure, the boiler may be hand-fired.

Our Offer to YOU: Give us the word, and we will make an engineering survey of your steam costs—without obligation to you. This survey will determine, on a conservative basis, what your fuel savings and betterments will be with Iron Fireman firing. *We will gladly work in cooperation with your own engineer, fireman or consulting engineer.* The experience of Iron Fireman in building and installing more industrial stokers than any other manufacturer is at your disposal. Telephone your local Iron Fireman representative, or send coupon.

Plant of the Hofmann Packing Company, Inc., Syracuse, N. Y., with delivery fleet in front.

THE IRON FIREMAN

This is the symbol of Iron Fireman—the machine that made coal an automatic fuel.

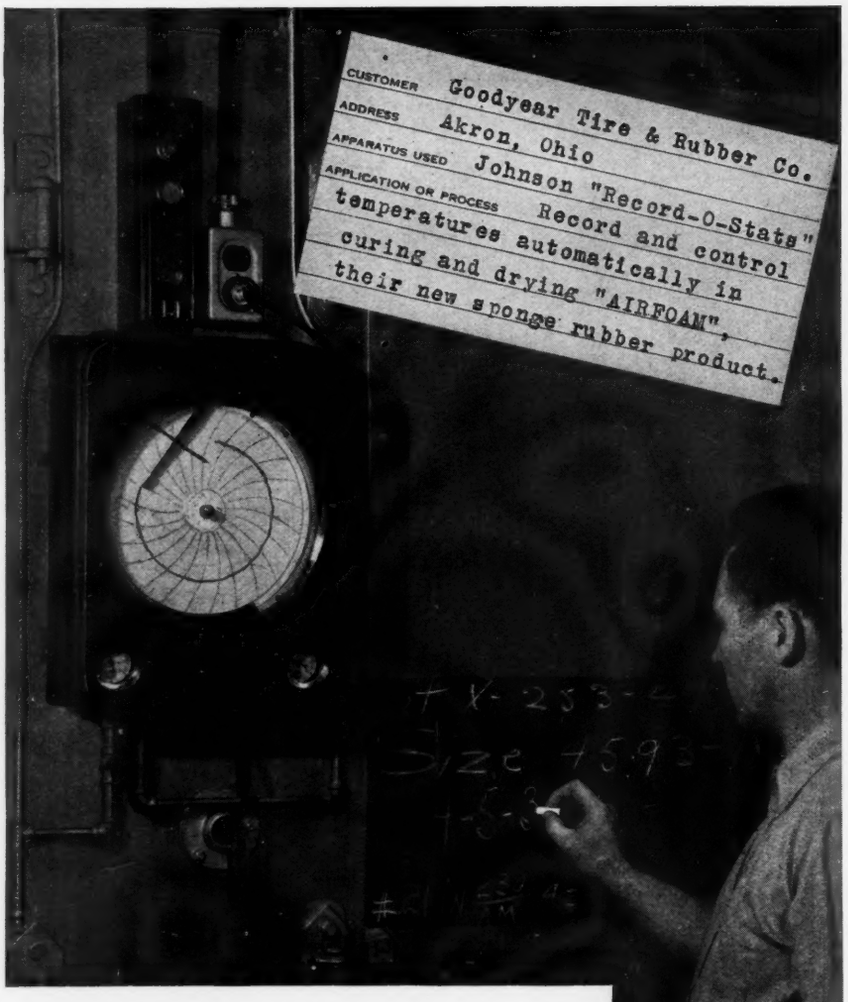
IRON FIREMAN
Automatic Coal Stoker

Iron Fireman Mfg. Co., Portland, Ore.; Cleveland; Toronto.
Mail to 3173 W. 106th Street, Cleveland, Ohio.

☐ Make a free engineering survey of our steam costs.
Send me: ☐ Industrial Catalog; ☐ Commercial Heating Catalog

Name _____

Address _____


CUSTOMER Goodyear Tire & Rubber Co.
ADDRESS Akron, Ohio
APPARATUS USED Johnson "Record-O-Stats"
APPLICATION OR PROCESS Record and control temperatures automatically in curing and drying "AIRFOAM", their new sponge rubber product.

The Problem:

PRECISE CONTROL OF TEMPERATURES

The Answer:

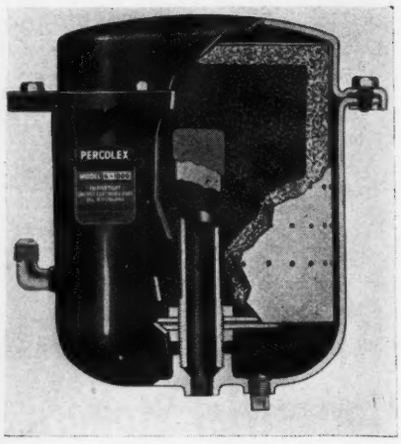
JOHNSON APPARATUS

Special problems in precise control of temperatures for manufacturing processes is "regular business" for Johnson engineers. Manufacturers, all over the continent, turn to this organization for the correct answer. A case in point is Goodyear's application of Johnson recorder-controllers to operate valves on steam coils in mold tanks and dryers . . . For the control of space heating and air conditioning, too, Johnson apparatus is used in the plant and office sections of countless industrial establishments.

Ask to have a Johnson Engineer call. There is no obligation.

JOHNSON SERVICE COMPANY

MILWAUKEE, WIS., AND DIRECT BRANCH OFFICES IN PRINCIPAL CITIES



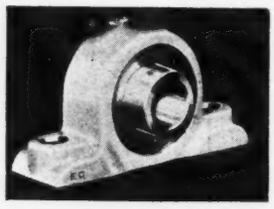
Oil Filter

"PERCOLEX" filter uses same processes as oil manufacturers, and oil filtered by this medium passes through six filtering agents: (1) perforated cartridge shell; (2) compressed waste; (3) water- and acid-absorbing earths; (4) second filter; (5) fabric filtering agent; and (6) fine mesh metal screen. Unit made for all types internal combustion engines, burning gas, gasoline or oil, and installations reported on automobiles, trucks, etc. Dust, dirt, and sediment collected by filter dumped into sump below oil cartridge.

The Dushane Co, Inc, 1516 S Wabash Ave, Chicago, Ill.

Pillow Block

"SERIES ED" consists of specially designed single-row bearings in die-cast housing, assembled to provide for shaft deflection and misalignment up to 1 deg. Neoprene seals

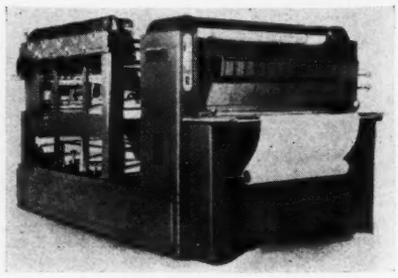


are of floating design claimed to eliminate friction and increase life of seals and bearings. Standard shaft sizes are ½, ⅝, ¾, 15/16, 1, 1⅛, and 1 3/16 in.

Ahlberg Bearing Co, Chicago, Ill.

Blue Printing Machine

MODEL "22" uses patented Actinic Arc Lamp and switch arrangement which per-



Speedy cleaners for any tube . . .

From the Lagonda and Liberty line of tube cleaners (a representative few of which are here illustrated), you can select the proper type and size of machine for cleaning tubes in boilers, superheaters, condensers, heaters or other tubular equipment. You can be sure that the cleaner we recommend for a given job will be exactly right for doing a quick, thorough job of removing any kind of scale deposit in small or large tubes, straight or curved. The small cleaner illustrated is remarkably successful in cleaning tubes in condensers, heat exchangers, etc.

Bring your problems to tube cleaning headquarters and profit by the broad experience of Lagonda and Liberty experts.

The latest developments in tube cleaners, accessories, etc., in bulletin Y-3. Write for your copy.

ELLIOTT COMPANY

LAGONDA-LIBERTY *Tube Cleaner Dept.*

Y-138 **SPRINGFIELD, O.**

District Offices in Principal Cities

LAGONDA-LIBERTY

TUBE CLEANERS FOR ALL INDUSTRIES

Keep your air lines oil- and water-free . . . . . SWENDEMAN SEPARATORS *do it automatically!*

TYPE C

Devices that simply trap oil and water in compressed air lines *and retain it* will never keep your compressed air lines *absolutely free* from oil and water. During the collection process some of it is bound to get through in the form of moisture.

In modern plants trapping devices that require manual draining are a thing of the past. Swendeman Separators discharge the water and oil as they are precipitated. It is done automatically and efficiently.

The installation is quickly and easily made.

They are made in three types.

TYPE A—used for all classes of industrial work where pressure variations are not necessary.

TYPE C—equipped with shut-off cock to permit of removing valve for cleaning without loss of air. A desirable feature where air is in constant use, particularly on the larger sizes.

TYPE D—has pressure regulator and gauge and is used when pressure regulation is essential, as in spray painting.

(Also manufacturers of the Dexter Valve Reseating Machines for reseating globe valves, gate valves and pump valve seats.)

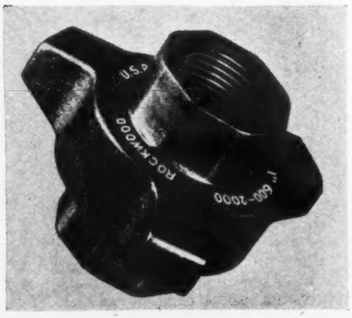
THE LEAVITT MACHINE CO.
10 EAST RIVER ST. ORANGE, MASS.
Canadian Distributors:—
The Canadian Fairbanks-Morse Company Limited
15 Branches Throughout Canada

mits lamps to be operated at any of three speeds. Washer made up of 3 horizontal water tanks, where paper floats while being washed. Aluminum drums used to dry paper evenly, and hypo and potash applications changed by lever. Has production rate of 24 lin ft per min, dc, and 18 lin ft per min ac. On smaller tracings, built in speeds allow use or slower blueprint paper, said to give better prints.

C F Pease Co, Chicago, Ill.

Hammer Lug Union

SPECIAL-ALLOY-STEEL hammer lug union is of 85,000-lb tensile steel, corrosion resistant. Triple-lug nut provides greater convenience in making up or breaking con-

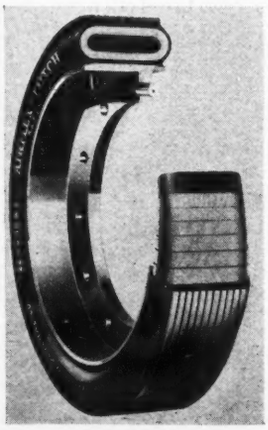


nections. No wrenches needed; lugs may be hit with hammer, iron bar, or anything handy. One of three lugs is always in position to be struck. Made for 600-lb W S P, 900 F, or 2000-lb hydraulic.

Rockwood Sprinkler Co, Worcester, Mass.

Rubber Clutch

AIRFLEX clutch uses same principal as certain automobile tires, that of narrow vanes or ribs of rubber, compressed into snake-like form, under pressure, providing adhesion to steel and other materials. Capacity of clutch regulated by internal pressure,



while outside is given special treatment to prevent deterioration by oil fumes. Rotary seal developed to deliver air to clutch, either by entering shaft at the end, or by straddle-type seal.

Fawick General Co, affiliate of General Tire & Rubber Co, Akron, Ohio.

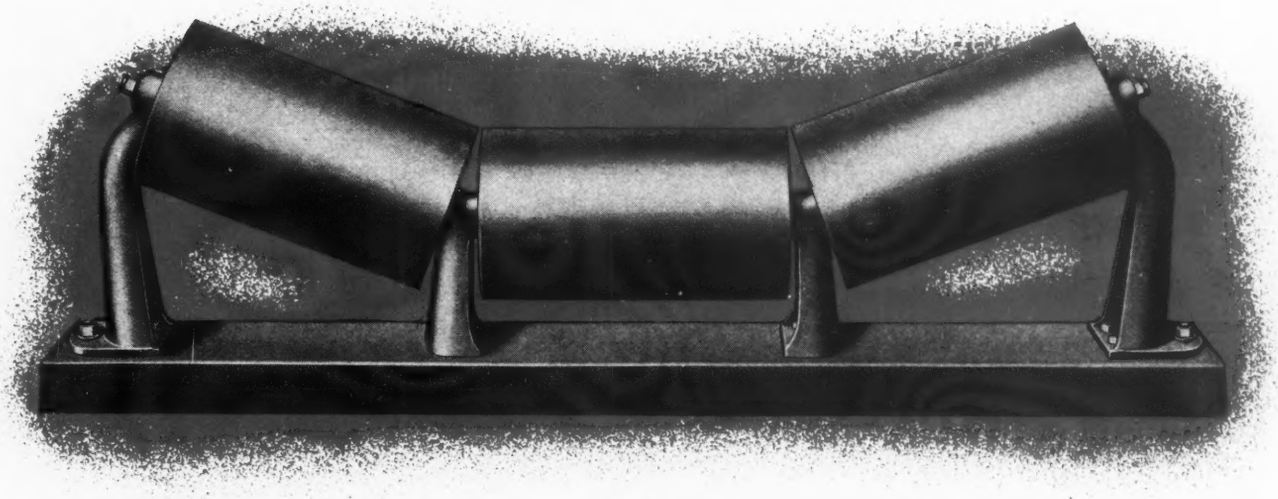
ROBINS *Improved*

RIGID TROUGHING IDLERS FOR BELT CONVEYORS

• Strength and Rigidity

• • Low Maintenance, Long Life

• • • Reduced Belt Wear



● Rigid Truss Construction (Non-Demountable Pulleys) — Streamlined malleable iron brackets of crescent section giving greatest strength, bolted to strong channel base with heavy bolts and automatic lock nuts — Machined bracket hubs for solid anchorage of shafts at both ends — Base, brackets, and shafts form solid, vibration-proof truss — Timken equipped steel or cast iron pulleys of ample load-carrying capacity— Interchangeable unit pulley assemblies with Timken races backed against heavy adjustable shaft shoulders with positive lock.

● ● Thorough Lubrication through Robins Patented Single-Shot System maintained indefinitely by new improved triple seals. Six seals per idler, each combining the leak-proof check-valve feature essential to single shot lubrication with felt-labyrinth-cork combination for super-protection against dirt or water.

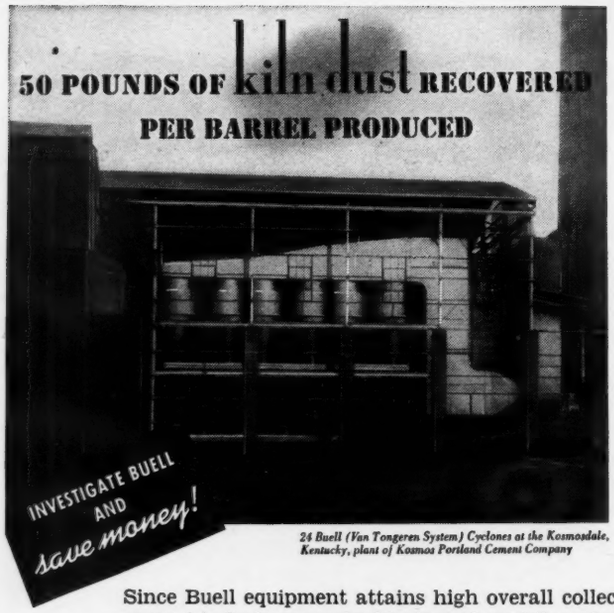
● ● ● True and Accurately Balanced Pulleys with close gap between them (1/4") insure minimum rolling friction and avoid creasing of belts—Streamlined bracket design avoids lodging of material between bracket and pulleys, insuring pulley rotation under all conditions.

ROBINS CONVEYING BELT COMPANY

NEW YORK
15 Park Row

CHICAGO
37 W. Van Buren St.

Boston
Charleston, W. Va.
Cleveland
Detroit
Pittsburgh
Philadelphia
San Francisco
London, England
Johannesburg, South Africa



24 Buell (Van Tongeren System) Cyclones at the Kosmosdale, Kentucky, plant of Kosmos Portland Cement Company

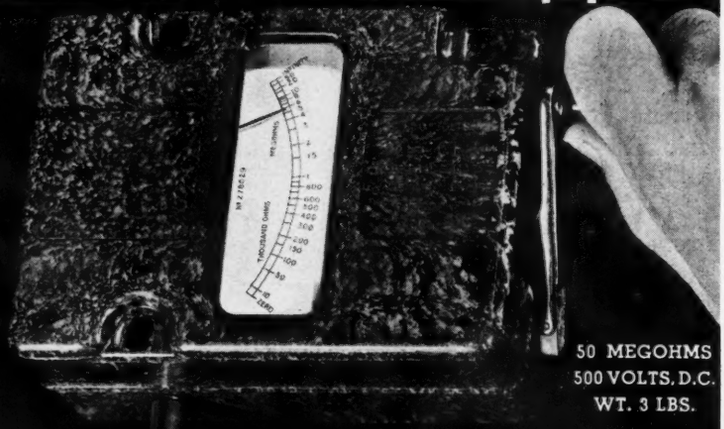
Since Buell equipment attains high overall collection efficiency in the cement industry on valuable dusts from kilns where the dust loading is from two to four times the dust load from stoker fired or pulverized fuel fired boilers, Buell equipment will eliminate any fly ash nuisance and give complete satisfaction to the community where the plants are located.

Kosmosdale Portland Cement Company investigated all of the better-known dust collection systems before it selected Buell Collectors—and this is but one of the important cement plants which have ordered Buell installations during the past few months.

BUELL ENGINEERING COMPANY INC
10 Cedar Street, New York
Sales Offices in Principal Cities

buell DUST COLLECTORS

PROTECT YOURSELF AND Your Electrical Equipment



50 MEGOHMS
500 VOLTS, D.C.
WT. 3 LBS.

. . . MIDGET "MEGGER"* Insulation Tester

Periodic tests of insulation resistance—using "Megger" instruments—give graphic warning of impending trouble in electrical equipment. They protect not only the equipment but *you* who are responsible for it. Start your trouble-prevention program today by ordering a Midget "Megger" Tester.

Price—$80 net, f. o. b. Philadelphia, complete with case.

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*Trade Mark Reg. U. S. Pat. Off.

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Engineers' Books

(Continued from page 114)

pletely, not abstracted, and represent original work on the part of the authors. They were selected from 1981 acceptable entries and represent an accumulation of new methods and applications of arc welding not yet available in any other form. The authors are acknowledged leaders in their fields.

Subject matter covers automotive, aircraft, railroad, watercraft, structural, furniture and fixtures, commercial welding, containers, welderies, functional machinery and industry machinery. Each study includes designs, calculations, procedures and other pertinent information showing how advantages attributed to arc-welded construction are obtained.

Piping

PIPING HANDBOOK (3rd Edition, 1939). *By J H Walker and Sabin Crocker, The Detroit Edison Co. Published by McGraw-Hill Book Co, 330 West 42nd St, New York, N. Y. 897 pages, 5x7 in., numerous illustrations and tables. Price $6.00.*

Significant changes in piping practice have required thorough rewriting of the handbook. Additional material on welded joints, ready-made welding fittings, welding-end valves, weldable alloy steels, new methods of pipe fabrication, new dimensional standards and Code requirements are several of the items on which new information is presented. Authoritative and accessible data exclusively devoted to piping design make this handbook indispensable to the piping engineer.

BRIEF REVIEWS

MIDWEST POWER CONFERENCE (Vol. II—1939.) *Sponsored by Armour Institute of Technology. Paper bound. Price $2.00.*—Booklet contains complete schedule of events, registration list, and text of all papers presented at Midwest Power Conference, April 5–7, 1939.

ELECTRIC POWER STATISTICS. *Report of production of electric energy in 1938, issued by Federal Power Commission. 54 pages, price $.25.*—The most comprehensive report issued by the commission gives the production of electric energy in the United States for the past year. Tables give individual state production. Includes, for first time, annual amounts of electric energy received in or delivered from each state.

HARDNESS CONVERSION TABLE FOR NICKEL-ALLOY STEELS (1939—revised). *Handy celluloid sheet compiled by Research Lab, International Nickel Co, 67 Wall St, New York, N. Y.*—Has, together with conversion tables, SAE specifications for nickel alloy steel, nickel chromium steels, nickel molybdenum steels, corrosion and heat resisting alloys, and scales of centimeters and inches.

H.P. COSTS LESS THAN E.P.*

YOU LOWER COSTS WITH COPPUS BLUE RIBBON TURBINES (Fractional to 150 H.P.)

1 **PRECISION WORKMANSHIP** — controlled by Johansson size blocks

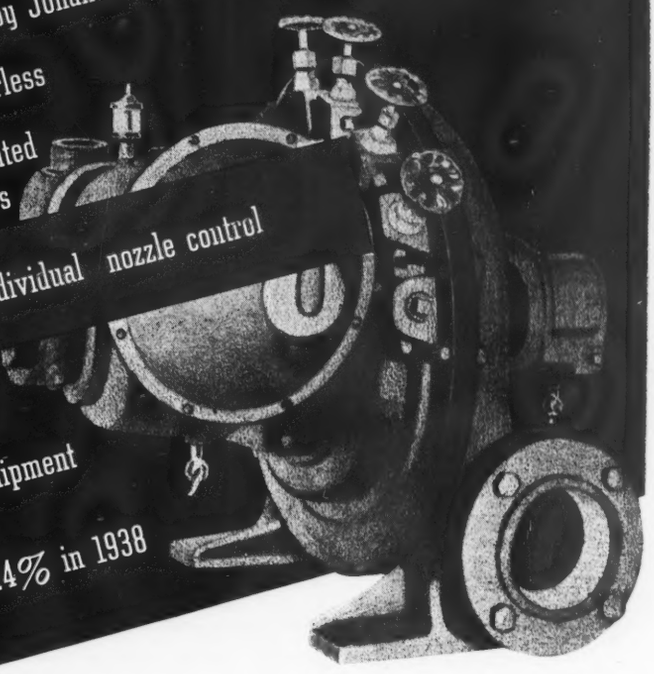
2 **ENCASED GOVERNOR** — slow speed leverless

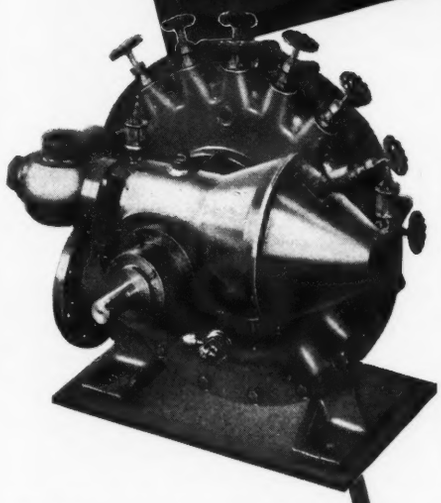
3 **SEPARATE SAFETY TRIP** — pilot-operated leverless

4 **PARTIAL LOAD ECONOMY** — by individual nozzle control

5 **DYNAMOMETER TESTED** — before shipment

6 **85% REPEAT ORDERS** — 85.6% in 1937 86.4% in 1938





COPPUS STEAM TURBINE SHOWING TEN NOZZLES of which SEVEN ARE CONTROLLED INDIVIDUALLY by HAND VALVES.

All Coppus Steam Turbines have as standard equipment a large number of nozzles with individually controlled hand valves so that it is possible to operate at close to full load efficiency when the H. P. requirements are reduced. By closing individual hand valves, full steam pressure can be carried in the steam chest, even if the actual load is temporarily as low as 30% of the full rating.

Less investment. Lower installation costs. These come to you when you pick the Coppus Turbine whose H. P. rating is *closest* to your job. Why buy a giant to do a midget's work?

Six sizes of the Coppus Blue Ribbon turbine (and six corresponding prices) make this a preferred product on the lists of the country's leading plants. For economy and long life — they look for the Blue band painted on the flange.

Learn more about Coppus top-notch performance and precision workmanship. Write today for bulletin 135-8. It also gives valuable turbine data, contains complete stories on Coppus vertical, horizontal, built-in speed reducer types. Steam, air, or gas-operated. Write for it. *Address* Coppus Engineering Corporation, 350 Park Ave., Worcester, Mass. *Sales offices in* Thomas' Register; *other products in* Sweet's.

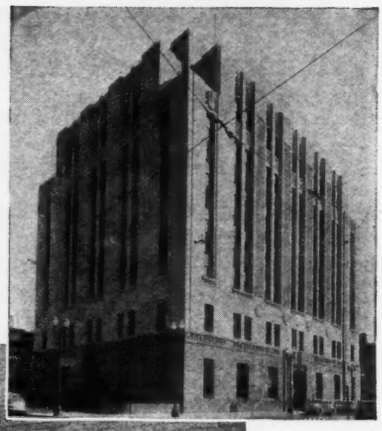
COPPUS

*E. P. Expensive elephant power for a job an inexpensive Coppus would do.

IMPORTANT TELEPHONE EXCHANGES

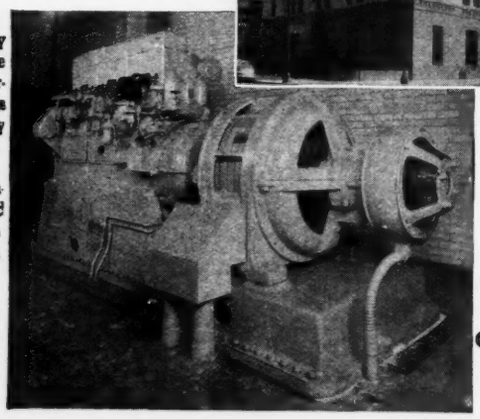
EMPLOY STERLING STANDBY GENERATOR SETS

The deluge of telephone calls that follow any catastrophe—reporting—appeals for help—the many imperative instantaneous demands must be served.



When utility power fails, these quick starting emergency generator sets furnish auxiliary power instantly.

The special engineering required for a successful installation, is available.



200 K.W. General Electric Generator driven at 1200 R.P.M. by Sterling Viking 6-cylinder 42 H.P. gasoline engine—Underwriters' approved for building installation

STERLING HIGH DUTY INTERNAL COMBUSTION ENGINES

STERLING ENGINE COMPANY

Home Office and Plant, 1270 Niagara Street, Buffalo, New York.

DEPT. C-1

Branch Office 900 Chrysler Bldg. New York, N. Y.

CONTROL THE VIBRATION ENCOUNTERED IN POWER PLANTS

WHEREVER ORDINARY NUTS FAIL TO HOLD—APPLY

UNSHAKO

The Nut that can't shake loose

Diesels, reciprocating engines, pumps, conveyors, generators, stokers, ash-handling equipment . . . all these will vibrate and eventually nuts may shake loose unless properly protected or constantly gone over. The easiest way is to install "Unshako" Self-Locking Nuts. Let their built-in locking rings stand guard for you and keep your equipment tight always. They won't fail you.

Fig. 1513

Pat'd and Pat's Pending.

Write us for full descriptive matter and further details about their use.

STANDARD PRESSED STEEL CO.

BRANCHES: BOSTON, DETROIT, INDIANAPOLIS

JENKINTOWN, PENNA. Box 577

BRANCHES: CHICAGO, ST. LOUIS, SAN FRANCISCO

Power Lines

(Continued from page 120)

ALBERT D MCPHEE, 78, retired, former operator of New Dam electric plant in Berwick, Me., died recently.

ALFRED L SAMPSON, 76, retired shop superintendent of the General Electric Co at Lynn, Mass., died recently at his summer home in West Alton, N. H.

ROBERT E KEYES, 54, chief engineer, Cooling & Air Conditioning Div, B F Sturtevant Co, died at the Metropolitan Hospital, Philadelphia, recently, following an attack of pneumonia. He had been with B F Sturtevant since 1927.

BERT HOUGHTON, 72, retired operating engineer of the Brooklyn Edison Co, died in the Brooklyn Hospital June 17, after an illness of several months. He was born in Pittsfield, Mass., attended the district school at Pittsfield and later was graduated from St. Johnsbury Academy. In 1892 he entered Cornell University, and upon graduation worked as draftsman and inspector. From an idea developed after

Bert Houghton

a visit to the Watertown Arsenal, he designed the first motor-operated gun carriage, which he exhibited at the World's Fair in Chicago, 1893. He also designed the electric mail-cancelling machine now used. In 1898 he was engaged by the Boston Electric Co to design and construct the new station. Following that he was employed by the rival Boston Edison Co, to rebuild its Atlantic Ave Station. When the two companies consolidated he was retained in an engineering capacity, and after 15 years with those companies, entered the employ of the Brooklyn Edison Co as assistant operating engineer. In 1920 Mr Houghton was appointed operating superintendent, holding that position until 1934, when he retired.

PERSONALS

G S CRANE, formerly in charge of the Sales Division of Cutler-Hammer, Inc, has been appointed vice-president in charge of sales and engineering. He has

New "RPM" DELO

[Diesel Engine Lubricating Oil]

WILL CUT YOUR DIESEL OPERATING COSTS

NEW "RPM" DELO which prevents ring-sticking and reduces filter-clogging to a remarkable degree, positively will not corrode or impair ANY type of Diesel engine bearings.

This has been proved by rigorous tests covering millions of miles of engine operation. The unvarying result is: NEW "RPM" DELO keeps *all* types of bearings in perfect condition!

Ask our Representative or your nearest Distributor to show you the authoritative Engineers' Report on NEW "RPM" DELO. This will give you the full results of our 10,000,000 miles and 90,000 hours of testing. By every test NEW "RPM" DELO assures clean-engine operation—free rings, clean pistons and cylinders, free oil passages, clean filters. Fact is, in a grueling test with NEW "RPM" DELO, engine filters remained free and unclogged after operating *6 times longer* than was possible with the highest quality straight mineral oil!

Yes, NEW "RPM" DELO spells *absolutely correct lubrication* for every type of Diesel engine, stationary or mobile, ashore or afloat. Cash in on all its service advantages yourself.

NEW "RPM" Diesel Engine Lubricating Oil now available everywhere in the gray barrel with the blue head

Order from Your Nearest Distributor as Listed Below:

IN THE UNITED STATES

"RPM" Diesel Engine Lubricating Oil:
The California Company (Montana only)
Humble Oil & Refining Company
Standard Oil Company (Indiana)
Standard Oil Company (Nebraska)
Standard Oil Company of California
Standard Oil Company of Texas
Utah Oil Refining Company

Diol "RPM" Diesel Engine Lubricating Oil:
The Carter Oil Company Tulsa, Oklahoma
Colonial Beacon Oil Company
Standard Oil Company of Louisiana
Standard Oil Company of New Jersey
Standard Oil Company of Pennsylvania

Kyso "RPM" Diesel Engine Lubricating Oil:
Standard Oil Company (Inc. in Kentucky)

Signal "RPM" Diesel Engine Lubricating Oil
Signal Oil Company

Sohio "RPM" Diesel Engine Lubricating Oil:
The Standard Oil Company (Ohio)

IN CANADA

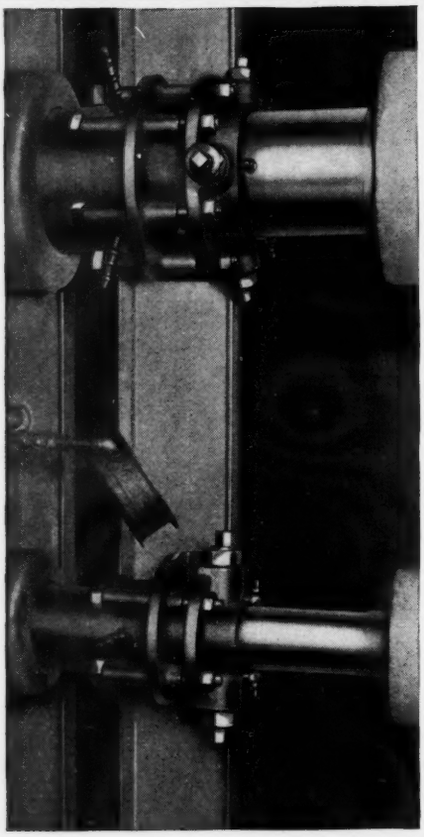
"RPM" Diesel Engine Lubricating Oil:
Imperial Oil Company Limited
Standard Oil Company of British Columbia Limited

THROUGHOUT THE WORLD

"RPM" Diesel Engine Lubricating Oil is also available through distributors in more than 100 other countries. Get in touch with your nearest distributor.

STANDARD OIL COMPANY OF CALIFORNIA

YARWAY
GUN-PAKT
EXPANSION
JOINTS



Big Automobile Company Uses 67 Yarway Joints

First purchased 3 years ago. Reordered 7 times to present total of 67 Yarway Gun-Pakt Joints, ranging in size from 3 in. to 14 in.

Why don't you select the Expansion Joint that is packed under full steam pressure. A twist of a wrench forces a special semi-plastic packing into the stuffing box by means of integral pressure guns. No need to remove old packing. New packing rejuvenates the old. No need to shut off steam. Write for Catalog EJ-1906.

YARNALL-WARING CO.
100 Mermaid Ave., Phila., Pa.

been associated with Cutler-Hammer for the past 29 years, serving in both the Engineering and Sales Departments. In 1931 he was elected to the board of directors and in 1935 appointed vice-president in charge of sales.

W J Westphalen, president and general manager of Laclede-Christy Clay Products Co, St. Louis, was re-elected for the second consecutive term as president of the American Refractories Institute. He has been with the company for over 30 years.

C W "Ted" Grange, formerly connected with the International Research Corp as regional sales manager, will join the Stewart-Warner Corp as advertising manager of the Alemite Div. He was previously a member of the Chicago advertising staff of the Curtis Publishing Co, and a reporter and news writer for the Associated Press.

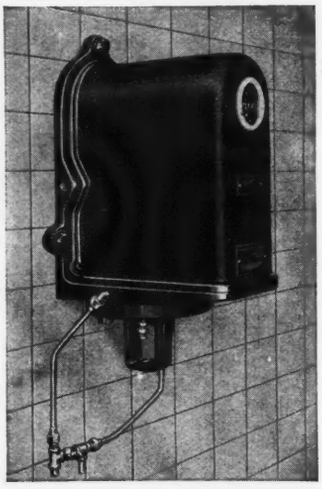
Frank S O'Neil has been appointed general manager of the Indianapolis plants of the Link-Belt Co. He was assistant manager for the past 7 years. Mr O'Neil joined the Link-Belt organization 33 years ago at the company's Chicago plant where he worked in the foundry, machine shop, and cost, rate-setting, and production departments. While at Indianapolis he served as assistant superintendent in charge of malleable-iron assembly, supt of the Ewart plant, and asst general mgr of both Ewart and Dodge plants.

William O Lippman, formerly superintendent of Air Conditioning Div, Westinghouse Electric & Mfg Co, has been appointed works manager of East Springfield, Mass., works. He joined the company in 1918, remaining at East Pittsburgh works until 1923, when he was transferred to the East Springfield works as supervisor of the Inspection and Testing Department. Later he took charge of the Industrial Relations Department. In 1936 he was made Superintendent of the Fan and Motored Appliance Div. He received his education at Harrisburg, Pa., Technical High School and Pennsylvania State College.

Howard A Gray has been appointed director, and Dan H Wheeler assistant director, of the Bituminous Coal Div, as announced by Secretary of the Interior Ickes. The division is the former National Bituminous Coal Commission, abolished by the latest presidential reorganization plan, and made a part of the Department of the Interior. Mr. Gray was associated for over 20 years with Joseph T. Ryerson & Sons Steel Co, and was also vice-president of the Yates-American Machine Co, Beloit, Wis.

L C McKay, 533 Mayo Bldg, Tulsa, Okla., has been appointed exclusive sales representative of the Reliance Gauge Column Co, Cleveland, Ohio. His territory will include the state of Oklahoma and the Panhandle section of Texas.

Harvey E Beidler recently assumed duties of chief engineer of the Celina, Ohio, municipal light and power plant, following approval by the Board of Public Affairs. He was formerly a teacher of physics and mathematics at Bluffton Col-



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For years the Gyroscope, with its complex and peculiar force actions, has presented an intriguing study to the engineer and scientist . . . Once used only as a toy or for personal transportation via the bicycle, in late years its principle has been adapted to new and useful services . . . Simplex is proud to offer for the first time in the industrial field an instrument employing gyroscopic action—The

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GYROMETER

an accurate and sensitive meter for totalizing the flow of any fluid . . . Built for a wide range of capacities and very reasonably priced.

Write today for technical data

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VALVE & METER CO.
6780 Upland St.
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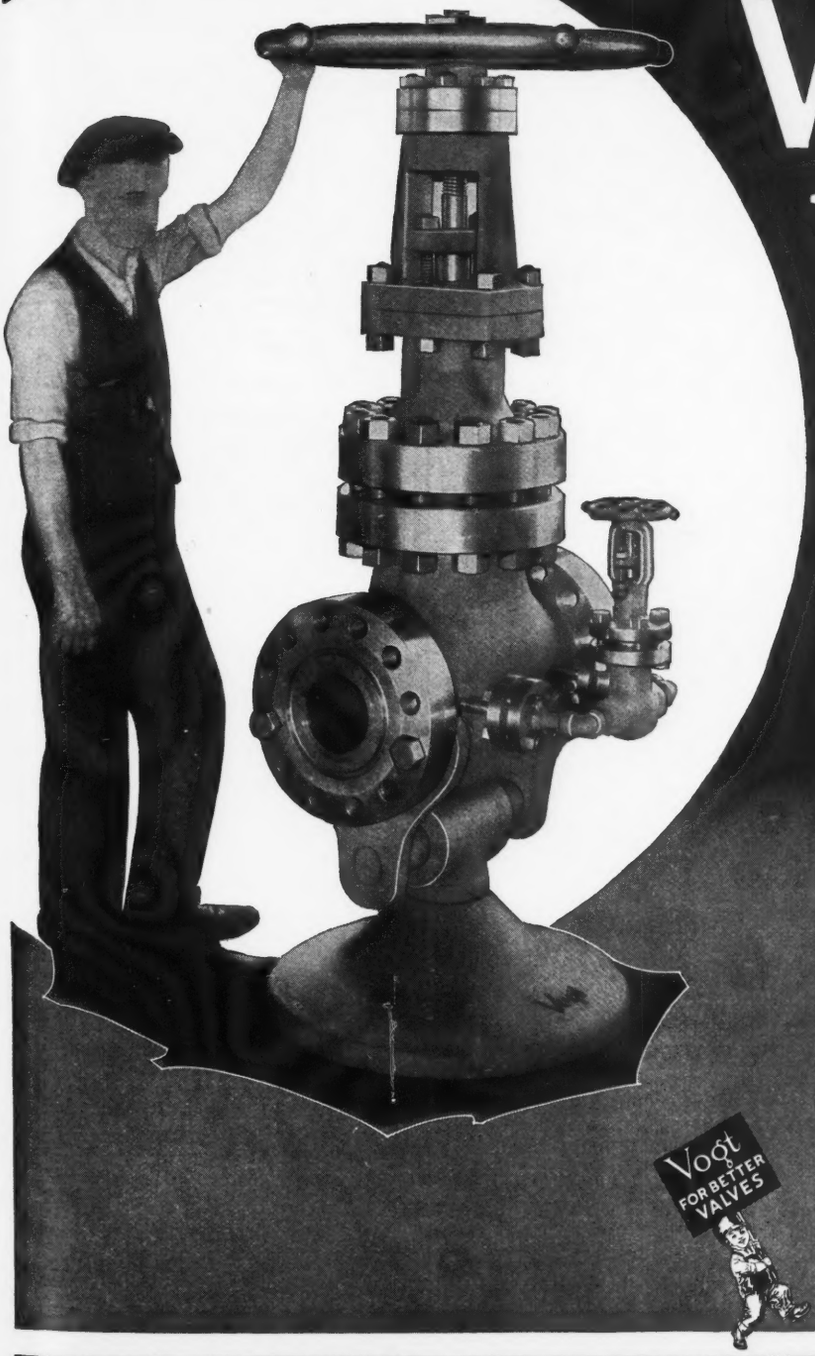
Worlds Largest DROP FORGED STEEL VALVE by Vogt



6" Size for 1500 lbs. WORKING PRESSURE at 950° F.

AGAIN, VOGT LEADS THE WAY with "bigger and better" DROP FORGED steel valves . . . built as Vogt only knows how to build them!

Valves like this are the product of our many years close cooperation with leading refinery, power plant and chemical plant engineers.

That's why you're always a step ahead when valves are Drop Forged by Vogt.

HENRY VOGT MACHINE CO., Inc., LOUISVILLE, KY.

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Do you want to **KNOW**

the . . .

TOTAL FLOW?

or the

RATE of FLOW?

If you need that vital information about your boiler feed or an unusual "hard to measure" liquid, you may now have it! Henszey Feed Water Meters and Flow Indicators are designed to take care of unusual measuring problems. In many and varied instances one or the other of these Henszey instruments have eliminated guesswork and instituted accurate measurement in its place.

Feed Water Meter

This sturdy meter operates within 2% of absolute accuracy regardless of heat or dirt in the water. It also measures the flow of a reciprocating pump.

Flow Indicator

If water passes through this indicator—it must register. Simple in operation, it goes right in the pipe line. There are no complicated parts to get out of order.

Write for more information stating your specific problem — No obligation for a survey and recommendations.

HENSZEY CO.

DEPT. D 8 WATERTOWN, WIS.

Some of the applications of these Henszey Instruments include the measuring of such liquids as:
BOILER FEED WATER
HOT DIRTY WATER
CONDENSATE
CHEMICALS
MILK
FLUID FOODS
AND MANY OTHERS.

HENSZEY

JOHN E CLARKE, 327 South La Salle St, Chicago, Ill., has been appointed agent for the Roller-Smith Co, Bethlehem, Pa., covering the eastern part of Iowa.

EARL N GRAF has been made manager of the Pittsburgh, Pa. branch of John A Roebling's Sons Co, Trenton, N. J.

MRS H S DEMAREST, who assumed the presidency of Greene, Tweed & Co, 101 Park Ave, New York, N. Y., upon the death of her husband, has announced her retirement from the presidency and active participation in the business.

L E SAWYER, formerly assistant general superintendent of Babcock & Wilcox Tubes Co, Beaver Falls, Pa., has been appointed general superintendent.

C L HARROD, president of the Laclede Power & Light Co, St. Louis, Mo., was elected president of Central States Power & Light Corp, succeeding B F Pickard, who was elected to the presidency of the Interstate Power Co, with headquarters at Dubuque, Iowa. Mr. Harrod will continue as chief executive of the Laclede company, which position he received in 1938. He is a past president of the Indiana Engrg Society and a charter member of the American Society of Military Engineers.

RICHARD P BROWN, recently appointed by Governor Arthur H James of Pennsylvania to be the first secretary of the new Department of Commerce of the Commonwealth of Pennsylvania is chairman of the board of the Brown Instrument Co, and vice-president of Minneapolis-Honeywell Regulator. One of the purposes of the new department is to suggest legislation which would be of help to Pennsylvania industries.

DAVID R CALHOUN has been named manager of the Industrial Div of Wilkening Mfg Co, Philadelphia, Pa. He has been with the company for several years, the past two being engaged in service engineering in connection with field sales. Following his graduation from Drexel Institute of Technology in 1934, he joined the Philco Radio & Television Co, leaving after a short time to enter the Wilkening Co. Webb Pedrick has been appointed to the position vacated by Mr Calhoun.

MORRIS E LEEDS, founder and president of Leeds & Northrup Co, is assuming the position of chairman of the board of directors, and CHARLES S REDDING, vice-president in charge of research and engineering, has been made president of the company, according to a new executive setup effective in July.

P Y DANLEY, Westinghouse Electric & Mfg Co, Springfield, Mass., was elected president of the Air Conditioning Manufacturers' Assn at the recent meeting in Hot Springs. He is manager of the Air Conditioning Dept and has been with the company since 1913. Other officers of the association are: S E Lauer, York Ice Ma-

ARROWHEAD GRATINGS & TREADS

Trade Mark Registered

Arrowhead Treads are strong and slip-proof. They are supplied with the defined nosing as shown, or plain. For interior or exposed stairs, the self cleaning, foot-gripping properties of Arrowhead treads are of valuable assistance in the promotion of safety and prevention of accidents.

Engineers Handbook Sent on Request

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IRON WORKS
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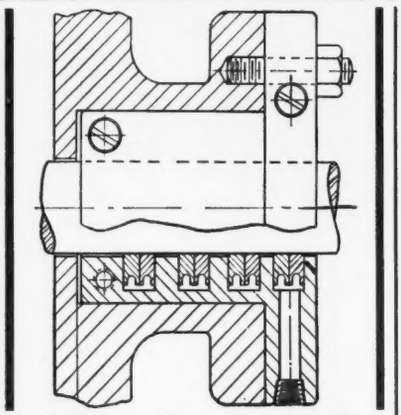

...Wears as long as any other working part of the engine

France is "full-floating" metal packing for piston rods and valve stems in any type of engine, pump or compressor. Prevents rod scoring and provides maximum sealing efficiency under any condition of speed, pressure or temperature. Write for details.

Sold on approval Satisfaction Guaranteed

THE FRANCE PACKING CO.
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Original **FRANCE METAL PACKING**

AGREED!

DESIGN . . . .

Bending moments caused by thermal expansion are greatly reduced when Pittsburgh Piping Creased Bends and Corrugated Tangents are used because of their inherent flexibility. Your design problems are further simplified by our ability to accurately prefabricate in one piece Creased Bends and Corrugated Tangents into piping assemblies of any practical design.

OPERATION . .

The more compact arrangement of piping made possible by the use of Pittsburgh Piping Creased Bends and Corrugated Tangents can lower your maintenance work and improve operating efficiency by providing more easily accessible valves and higher head clearances. Auxiliary equipment can be conveniently located without danger of excessive end reactions.

ECONOMY . . .

When you are considering the modernization of your existing power system, keep in mind that space-saving features of Pittsburgh Piping short-radius Creased Bends and superflexible Corrugated Tangents often permit the installation of a vastly more complex system in an existing structure, thus eliminating the necessity of expending capital for a new building.

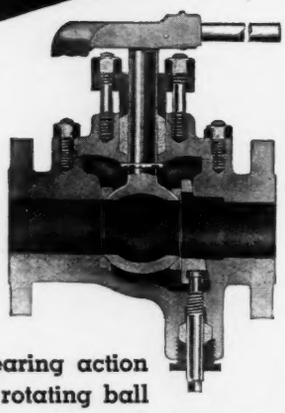
PITTSBURGH PIPING & EQUIPMENT CO., 10 FORTY-THIRD STREET, PITTSBURGH, PA.

BRANCH OFFICES IN PRINCIPAL CITIES

Pittsburgh Piping

CREASED BENDS WITH CORRUGATED TANGENTS

They Cut Through Foreign Matter



THE shearing action of the rotating ball plug in Sphero Valves cuts through scale or thick viscous materials as it revolves when opening or closing. This, and the perfect seating of the ball, assures a tight, leak-proof seal.

The round portway in the plug gives an opening the same size as in the pipe and reduces pressure loss.

Wear on the seat rings is reduced to a minimum by the rotary movement of the ball because they are not in contact with the flow when valve is wide open or closed.

Fairbanks Sphero Valves are easier and quicker to operate. Working parts can be renewed on the line. Other features which recommend them for blow-off purposes and services where a full flow, quick-acting valve is required, are explained in catalog No. 21. Write for a copy.

THE FAIRBANKS CO.

397 Lafayette St. New York, N. Y.

Boston, Pittsburgh—Distributors in Principal Cities
Factories: Binghamton, N. Y.; Rome, Ga.

Fairbanks
Sphero Valves

chinery Co; P A McKittrick, Parks-Cramer Corp; and W B Henderson, Washington, D. C.

D J ERIKSON has been appointed vice-president in charge of sales for Hagan Corp, Pittsburgh, Pa., and its subsidiaries, Hall Laboratories, Inc, the Buromin Co, and Calgon, Inc. He will have charge of the sale of Hagan Automatic Combustion Control for power plants and for heavy-duty furnaces in the steel industry. He has been associated with the company in various capacities for 20 years.

B M HORTER has been appointed general sales manager for Cutler-Hammer, Inc. Prior to his appointment Mr. Horter was in charge of the Resale Sales Div at the Milwaukee headquarters, and is the holder of a number of patents in motor-control apparatus. He has been with the company for over 18 years.

G C DAVIS was recently elected president of the Manitoba branch of the A S H & V E. He was installed at a joint meeting of the Minneapolis and Manitoba branches of the society held at Detroit Lakes. Mr. Davis is vice-president of Winnipeg Heating Co, Winnipeg.

DR H J MACLEOD, of the University of British Columbia, has been appointed technical advisor to the Public Utilities Commission and will be engaged in special work.

BUSINESS ITEMS

CUTLER-HAMMER, INC, Milwaukee, Wis., announces election of E W Seeger and P B Harwood as manager of the Development Dept, and manager of the Engineering Dept, respectively. Mr Seeger has been with the company since 1913 and was formerly in charge of the Production Engineering Dept. Mr. Harwood joined the company over 20 years ago, and held the position of assistant manager of Production Engineering Dept prior to his appointment.

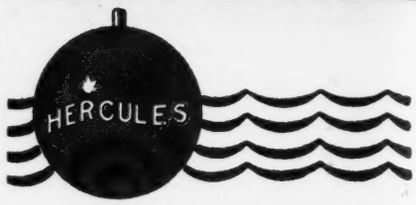
V D ANDERSON Co, of Cleveland, Ohio, recently moved into a new 2-story office building, fronting on West 96th St, Cleveland. Opening of new office marks completion of 59th year of service. The firm was founded in 1880 and incorporated as the V D Anderson Co in 1888.

T B WOOD'S SONS Co, Chambersburg, Pa., announce appointment of Arnold Electric Co, Arlington, Va, as one of their distributors. Engrg dept will be available to assist transmission users. Also announce appointment of Hartley-Rose Belting Co to serve as factory branch in Pittsburgh.

WHEELCO INSTRUMENTS Co, Chicago, Ill., appointed Industrial Equipment Co, 732 M & M Bldg, Houston, Texas, and Frank P Fisher, 1608 Audubon St, New Orleans, La., as representatives in their respective territories.

CONTROLLED STEAM GENERATORS, INC, McGraw-Hill Bldg, New York, N. Y., announces the appointment of Edwin Lundgren as vice-president in charge of sales.

HERCULES
Seamless Copper
FLOATS



GUARANTEED TO STAND UP!

Every Hercules Float carries our guarantee to stand up under 350 lbs. working pressure and 500 degrees temperature.

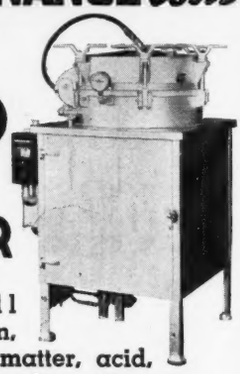
Fabricated of seamless copper under our special spinning process, Hercules Floats are uniform in thickness and high in mechanical strength.

You can depend on Hercules for floats—in standard shapes up to 10 in. and in special types to your specifications—to give long, dependable, economical service.

Insure care-free maintenance of water level in your heaters, tanks, reservoirs and other equipment by specifying "HERCULES."

HERCULES FLOAT WORKS
200 Franklin St.
SPRINGFIELD, MASS.

Cut DIESEL MAINTENANCE Costs with a HILCO OIL RECLAIMER



Removes all solids, carbon, sludge, tarry matter, acid, fuel dilution and moisture.

Restores color of oil.

Directly connected to engine lube system for continuous or intermittent electric automatic operation.

Serviced only once in 24 hours.

No oil handled by operator—Saves labor.

Low operating temperatures.

Keeps your engine CLEAN—ALL the time.

Write for descriptive folder.

THE HILLIARD CORPORATION
4 West 4th St. Elmira, N. Y.

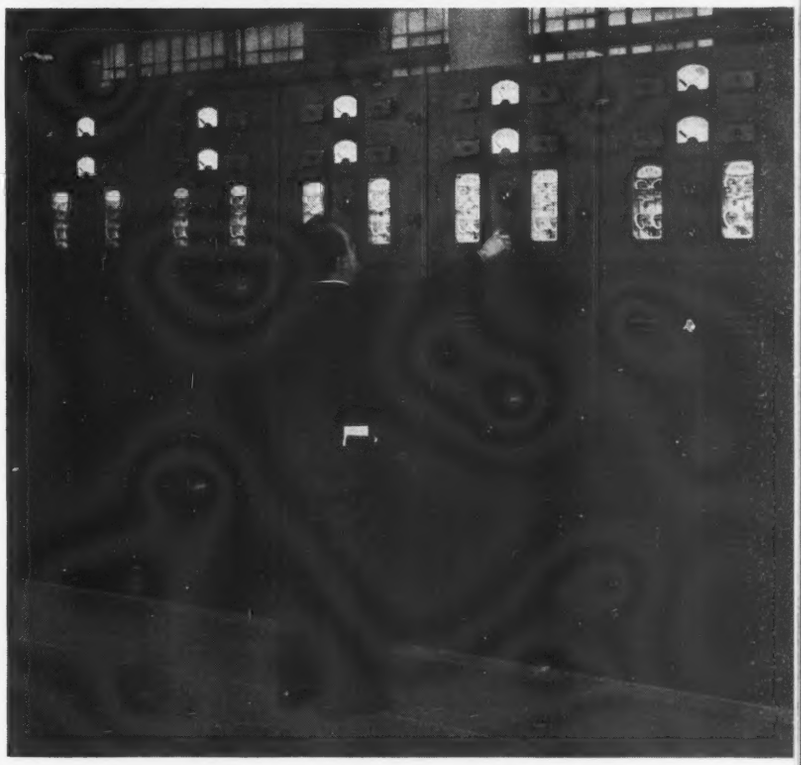
HE REALIZES THE IMPORTANCE OF "IC"

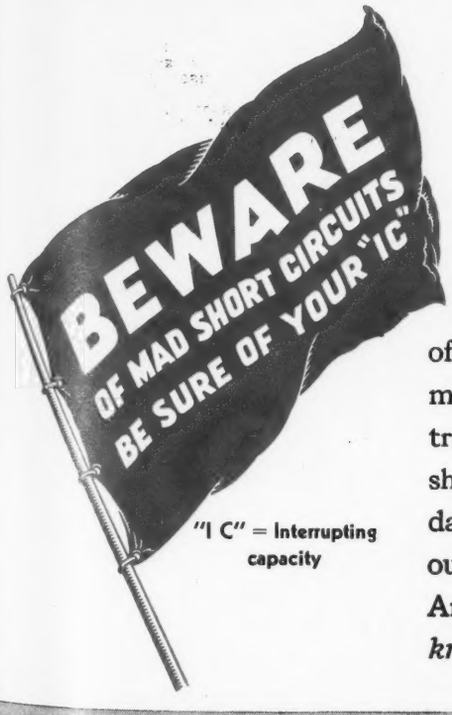
That's Why He's Installing G-E Air Circuit Breakers on All Branch Circuits

BESIDES adequate interrupting capacity ("I C"), G-E air circuit breakers provide overcurrent protection, with adjustable time delay. And you can restore service at once, safely, just by turning a handle. By providing three-phase interruption, single-phasing of motors, with all its harmful effects, is prevented. Because of their trip-free action, these circuit breakers cannot be held closed against short circuits. They are designed for interrupting ratings up to 80,000 amp.

For Main Circuits He Bought G-E Air Circuit Breakers Assembled as a Completely Enclosed Switchboard

This assembly of G-E air circuit breakers is installed as a unit. All you need do is to connect the leads. Being completely dead-front, it offers the advantage of safety over old-fashioned boards that have exposed live parts.





"I C" = Interrupting capacity

THE severity of a short circuit depends largely on the capacity of the transformers that feed the circuits and it can *not* be determined by the normal load on the circuit. As plant loads have grown, transformer capacities have been materially increased. Therefore, short circuits present an ever-increasing hazard. They gravely endanger personnel and property wherever the power supply has outgrown the interrupting capacity ("I C") of the protective devices. Are you sure of your "I C"? With G-E air circuit breakers of *known* interrupting capacity, you *can* be sure.

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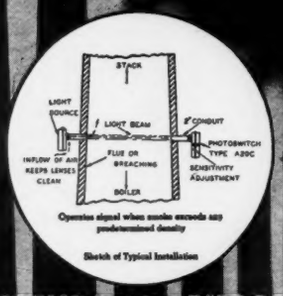
PHOTOSWITCH
Electric Eye
INCREASES FUEL ECONOMY—AVOIDS SMOKE NUISANCE



Operates signal when smoke exceeds any predetermined density
Sketch of Typical Installation

DEPENDABLE—RUGGED
• GUARANTEED •

SOLVES YOUR OTHER CONTROL PROBLEMS
Wherever objects are counted, electrical machinery automatically controlled, or warning signals are used, PHOTOSWITCH will do the job better and more economically.
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District offices in all principal cities

Save Air—Save Dollars
ROCKWELL BLAST GATES

Threaded Slide Type

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For Low Pressure Air
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Write for catalog No. 3760
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W. S. ROCKWELL COMPANY
50 CHURCH ST., NEW YORK

• clearances controlled—
• oil pressure maintained

On this diesel, LAMINUM babbitted shims (pat'd) are standard . . . for the important oil pressure control and precision adjustment of main and connecting rod bearing clearances. The same easy accuracy in service adjustments as in assembly! You simply peel off .002 in. (or .003 in.) laminations. Always a clean shim surface! Laminum sample on request.

LAMINATED SHIM CO., INC. 21-60 44th Ave., Long Island City, N. Y.
Cleveland Detroit Milwaukee
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LAMINUM
Precision adjustment SHIMS

STRAWS

Pointing the way business winds blow

ALABAMA——Veterans' Administration, Washington, D. C., has low bid from Rust Engrg Co, Clark Bldg, Pittsburgh, Pa., for boiler and boiler plant equipment for power house at institution at Tuscaloosa, and will make award soon.

Purity Ice & Creamery Co, Selma, plans 1-story addition to refrigerating and quick-freezing plant. Cost about $25,000.

ARIZONA——Bureau of Reclamation, Denver, Colo., contracted Worthington Pump & Machinery Corp, at $106,177 for 3 motor-driven pumping units and accessories for pumping station No. 1, gravity main canal, Gila project.

Phoenix Union High School and Junior College Dist, Phoenix, contracted H L Royden, Phoenix, for central-heating plant at high school, at $42,450. Lescher & Mahoney, Title & Trust Bldg, Phoenix, architects.

ARKANSAS——Arkansas Power & Light Corp, Harvey C Couch, president, Pine Bluff, is expected to start construction early in September of hydro-electric dam and power plant on upper Ouachita River at Blakely Mount. Cost from $6,000,000 to $8,000,000.

CALIFORNIA——Bureau of Reclamation, Federal Bldg, Sacramento, will receive bids until Aug. 23 for construction of Friant dam on upper San Joaquin River, about 20 mi from Fresno, Central Valley project, comprising gravity-type concrete dam, 300 ft high and 3430 ft long. Will require about 4400 tons of steel conduits and pipe, and 6000 tons of steel gate-valves and machinery, to be furnished by Government, and for which bids will be asked soon by Sacramento and Denver, Colo. offices of Bureau. Dam will back up San Joaquin River about 15 mi, creating a reservoir of 520,000-acre-ft capacity, and is estimated to cost $14,000,000.

Water and Power Commission, 205 S Broadway, Los Angeles, contracted Rees Blow Pipe Mfg Co, 5714 Morgan Ave, Los Angeles, at $43,190 for installation of induced-draft system at steam-electric power plant at Seal Beach.

Schumacher Wall Board Corp, 5721 San Pedro St, Los Angeles, plans plant on 12-acre tract of land on Firestone blvd, South Gate district, recently acquired. Cost over $1,000,000, with power equipment.

Chrysler Corp, 341 Massachusetts Ave, Detroit, Mich., has approved plans for two additions, 160 x 280 ft, and 160 x 260 ft, to branch automobile assembling plant at 5800 Eastern Ave, Los Angeles. Work will proceed at once. Cost over $175,000.

COLORADO——Bd of Directors, Colorado State Hospital, Pueblo, contracted Hendrie & Bolthoff Mfg Co, Denver, at $62,422 for furnishing and installing two boiler units, 40,000 lbs steam per hr capacity, in power house at institution, including superheater, stoker, forced-draft fan and accessories. Also made award to J V Boland Construction Co, 2715 Dalton Ave, St. Louis, Mo., for 10-ft. interval dia. concrete stack, 235 ft high. Architectural Associates, Thatcher Bldg, Pueblo, architects.

CONNECTICUT——International Silver Co, Meriden, contracted Alphons Custodis Chimney Construction Co, 80 Broad St, New York, N. Y., for brick stack for power house on Cherry St.

Howard Cleaners, Inc, 452 West Main St, New Britain, plans boiler house for plant service, with boiler unit, and stokers. Application made to zoning board for permission.

GEORGIA——Van Raalte Co, Inc, 417 Fifth Ave, New York, N. Y., has approved plans for new 1- and 2-story hosiery mill at Blue Ridge, and will proceed with work at once. Boiler house will be built. Cost about $175,000.

IDAHO——State Building Dept, Boise, Malcolm Stevens, has arranged appropriations for following work: New central-heating plant at state school for boys at Gooding; improvements in power house at Southern Branch, University of Idaho, Pocatello, with 3000 lb boiler unit. Improvements in power house at institution at Blackfoot and installation of 4000 lb boiler and accessory equipment.

ILLINOIS——The Sangamo Electric Co, 11th and Converse streets has awarded contract to Austin Co, 510 North Dearborn St, Chicago, for construction of 1-story 150 by 200-ft addition to its factory. Cost estimated at $75,000.

Casey received new bids on construction of municipal light and power plant,

Prefabricated by Kellogg

Illustrated above is a 30" O.D. x ½" thick turbine exhaust header under test in the Kellogg shops. This exhaust header, designed for operation at 300 lb. at 900° F., was completely fabricated from carbon moly plate by the Kellogg "Masterweld" process. Construction was according to paragraph U68 of the A. S. M. E. Code for unfired pressure vessels and the unit was completely X-rayed and stress relieved.

Consulting engineers, central station, power, process and marine plant operators will find in Kellogg prefabricated piping a satisfactory answer to many of their intricate piping problems, whether they be unusual operating conditions, high temperatures and pressures, space limitations or high moments due to thermal expansion.

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"Masterflex" Prefabricated Piping Systems · "Masterweld" pressure vessels for Power, Refinery and Chemical Industries. Heat Exchangers. Pyrolytic Cracking Units. Thermal and Catalytic Polymerization Units · JUIK Processes for Lubricating Oil Plants. Plastic Refractories · Radial Brick Chimneys.

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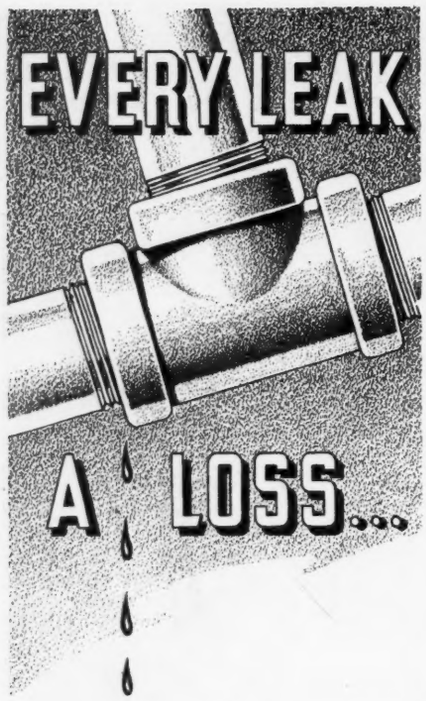
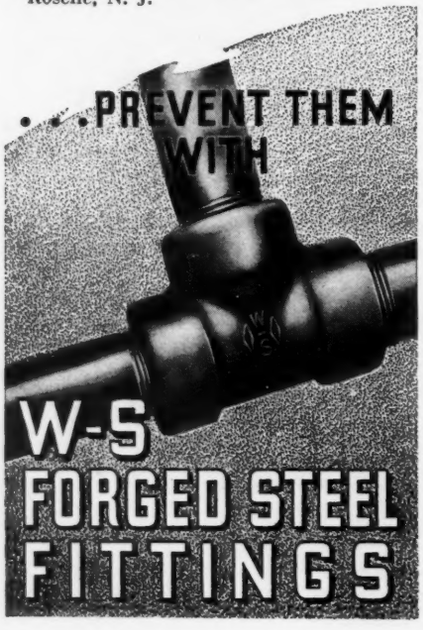


High pressures and high temperatures demand safe, dependable fittings. On pipe lines carrying oil, gas, steam, water, ammonia and other liquids under high pressures and temperatures the use of anything less adequate than the flawless strength inherent in W-S Forged Steel Fittings is a compromise that ultimately results in costly, if not dangerous, pipe line failures and prohibitive pipe line maintenance costs.

W-S Fittings are drop forged from open hearth steel having a tensile strength well in excess of 75,000 pounds. They are bored from solid forgings and have walls that are of uniform thickness and smooth passages that assure uninterdupted flow.

Accurately cut threads, perfectly aligned insure tight joints that stay tight.

W-S Fittings are available in screw end and socket welding types. Write for Bulletin A-3—The Watson-Stillman Co., Roselle, N. J.



with diesel equipment. Alternate plan provides for addition and improvements to the present plant. J F Huitt, 33 North Meramec avenue, Clayton, Mo., engineer under first project, while plans for alternate project were prepared by Ralf Toensfeldt, 411 Security Bldg, St. Louis, Mo.

Phillips Pipe Line Co, Bartlesville, Okla., affiliated with Phillips Petroleum Co, same place, plans 8-in. welded-steel pipeline from point in Illinois, connecting with present system, to East Carondelet, for gasoline transmission. Pumping stations will be installed at points along route for booster service. Cost estimated over $800,000.

Bd of Education, 228 N LaSalle St, Chicago, plans central-heating plant in Fuller school at 537 E 42nd St. Cost about $350,000. John C Christensen, address noted, architect for board.

W H Barber Co, 3650 S Homan Ave, Chicago, plans addition to boiler house, 24x36 ft, with boiler unit and accessory equipment. Edward G McClellan, 7439 Cottage Grove Ave, architect.

Dreymiller Brothers, Hampshire, have approved plans for new 1-story cold-storage plant with locker system, 38x50 ft. Cost about $30,000. Work scheduled to begin at once.

State Division of Architecture and Engrg, Springfield, contracted Elliott Co, Ridgeway, Pa., at $16,197 for engine-generator unit, for power house at state hospital, East Moline.

Abbott Laboratories, 14th St and Sheridan Rd, North Chicago, contracted Babcock & Wilcox Co, for watertube boiler unit, capacity of 40,000 lb steam per hr, and equipment for power house addition at chemical plant. Battey & Childs, 231 S LaSalle St, Chicago, architects.

INDIANA——Columbia City plans improvements in municipal power plant, with turbine-generator unit and accessory equipment. Cost estimated at $120,000. Frank T Schultz, superintendent at plant, in charge.

Huntington is considering municipal power plant and waterworks pumping station. Cost about $150,000.

Logansport plans improvements in power plant, with installation of additional equipment. Cost about $50,000. Charles Ammerman, Century Bldg, Indianapolis, consulting engineer.

Procurement Div, Public Works Branch, Treasury Dept, Washington, D. C., plans central-heating plant in new postoffice, court house and customs building at Evansville, for which bids will be asked in fall. Appropriation of $600,000 authorized.

Bd of County Commissioners, Court House, Wabash, plans improvements in central-heating plant for court house, including new boiler, stoker and accessories. County engineer in charge.

Rensselaer contracted William R Dunkin & Son, Huntington, for remodeling and improving municipal power plant. Also made award to Schubert-Christy Co, St. Louis, Mo., for cooling tower. Contracts will be let soon for other miscellaneous equipment. Cost about $70,000. John M Moore & Son, Indiana Pythian Bldg, Indianapolis, consulting engineers.

IOWA——Young & Stanley Inc, Muscatine, consulting engineers will complete preliminary studies and report on proposed improvements at New London municipal light and power plant. Installation of diesel generating unit under consideration.

Montezuma will award contracts soon for three 650-hp diesel-generator units for new municipal power station. Will also place award for station building, 54x56 ft. Cost about $136,000. Financing arranged through bond issue. A S Harrington, Baum Bldg, Omaha, Neb., consulting engineer.

Bancroft contracted Fairbanks, Morse & Co, at $85,042 for equipment for municipal power plant, including two 450-hp diesel generator units. Fund of $100,000 available for project. A S Harrington, Baum Bldg, Omaha, Neb., consulting engineer.

Soy Bean Processing Co, Waterloo, plans power house at mill, with 1500-lb boiler unit, and stokers. Cost close to $40,000. Helmick, Edeskuty & Lutz, Essex Bldg, Minneapolis, Minn., consulting engineers.

Iowa Public Service Co, Commercial St, Waterloo, has approved plans for propane-gas-mixing and storage plant at Waverly, with 2 air-compressors, 25,000-cu. ft. capacity steel storage tank, etc.

Woodbine will award contract for 3 diesel-generator units for new municipal power plant, for which a bond issue of $115,000 was voted recently.

New Hampton has approved plans for remodeling municipal power plant, with new 1000-kw turbine-generator and accessories, superheaters for existing boilers, and pumping machinery. Estimated cost $183,125. Ralph D Thomas & Associates, Inc, 1200 Second St S, Minneapolis, Minn., consulting engineer.

People's Natural Gas Co, Omaha, Neb., plans natural-gas distribution system at Paullina, including control station and other operating facilities. Franchise is being secured.

Denison plans improvements in municipal power plant, with installation of additional equipment. Surveys and estimates of cost will be made.

Preston will award contracts soon for three 75-kw generator units, or two 120-kw generating units (alternate proposition), and equipment for municipal power plant. Ralph W Gearhart, Cedar Rapids, consulting engineer.

KANSAS——John Morrell & Co, ft of Quincy St, Topeka, meat packers, have approved plans for 6-story and basement addition, 100x150 ft. Cost over $100,000 with power equipment, etc. Henschien, Everds & Crombie, 59 E Van Buren St, Chicago, architects and engineers. Main offices of company are at Ottumwa, Iowa.

Wellington, contracted Babcock & Wilcox Co, for 2 boiler units for municipal power plant, where improvements will be made. Contract has been let to Universal Construction Co, Coffeyville, for addition to station. Black & Veatch, 4706 Broadway, Kansas City, Mo., consulting engineers.

State Bd of Social Welfare, State House, Topeka, contracted Murray Iron Works Co, Burlington, Iowa, at $11,430 for 200-kw turbine-generator for power house at state hospital at Larned.

KENTUCKY——Owenton plans electric generating plant and distribution system to cost about $50,000. Ray W Channaberry, Inc, Realty Bldg, Louisville, consulting engineer.

Corbin contracted Harlan Construction Co, Harlan, at $89,376 for new building for municipal power plant and waterworks station. Equipment awards are being made separately. Burns & McDonnell Engrg Co, 107 W Linwood Blvd, Kansas City, Mo., consulting engineer.

Constructing Quartermaster, Fort Thomas, contracted Peck, Hannaford & Briggs Co, Court and Sycamore Sts, Cincinnati, Ohio, at $10,925 for installation of stokers in local power plant.

LOUISIANA——Evangeline Packing Co, Lafayette, recently organized, plans cold-storage and refrigerating division at local meat-packing plant. Cost about $60,000.

Morgan City plans improvements in municipal power plant and waterworks station, including additional equipment. Cost about $110,000. Bond issue is being arranged.

Bayou State Oil Corp, Hosston, has approved plans for new 4½-in. welded-steel pipeline from oil-field area at Rodessa, to refining plant at Hosston. Will be used for natural gas transmission for processing for natural gasoline production. Line will have capacity of about 1,500,000 cu ft daily.

Mansfield plans natural-gas distribution system and has contracted Jack Lanier, 560 Gladstone Blvd, Shreveport, for installation of 6-in. welded-steel pipeline from city to recycling plant of Portex Oil & Gas Co, near Joaquin, Tex., for natural-gas transmission for local service. Control station will be built. Cost about $135,000.

MARYLAND——Constructing Quartermaster, Holabird Quartermaster Depot, Baltimore, has low bid from J W Marchant, 2901 Edgewood St, Baltimore, at $49,849 for central-heating plant for Ordnance School, Aberdeen Proving Grounds, Aberdeen, and will make award soon.

Western Maryland Railway Co, Baltimore, plans early rebuilding of 75-ft coaling tower at engine house at Hanover, Pa., recently destroyed by fire.

Southern Maryland Tri-State Cooperative Association, Welcome, Wendell Reed, president, plans steam-electric power plant for power service for electric system. Cost about $50,000. Total fund of $160,000 has been secured through Federal aid for power station and line construction.

MASSACHUSETTS——Boston Housing Authority, 10 Oliver St, Boston, John Breen, chairman, plans central-heating plant in development in Charlestown district, comprising several large buildings. Work is scheduled to begin soon. Cost about $6,200,000. John M Gray, 175 High St, Boston, architect.